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JOURNAL OF FORESTRY

VOL. XXIX JANUARY, 1931 No. 1

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

EDITORIAL

TREES AND FORESTS FOR COMMEMORATION PURPOSES

IN SPONSORING a tree planting program to commemorate the 200th anniversary of the birth of George Washington, the American Tree Association has hit upon a gracious and appropriate method of aiding the general celebration. The official observance of the anniversary does not begin for another year, but the Association has already gotten its program under way and it expects to have many commemoration trees in the ground ready for dedication in 1932.

George Washington was a lover of trees and had a keen appreciation of their meaning and worth, whether they stood in the forest, in a park, or in an orchard. The Association's effort is therefore all the more fitting. Furthermore, a tree makes a more lasting and useful memorial than a ringing, flag-waving speech. Years after the commemoration period has passed and the speeches are forgotten, the Washington memorial trees will stand, symbols of the abounding faith and courage of the First President. The Association proposes to have at least 10,000,000 trees planted for the anniversary. The more widely they are distributed the more far reaching will be their influence. American cities and towns need trees on streets, lawns, backyards, and unused spaces to help hide their innate ugliness. Ten million trees wisely selected and planted will help tremendously to make our daily lives more cheerful and pleasant and will teach us to appreciate trees for their own sakes and for what they can give us in utilitarian forms, to say nothing of being constant reminders of Washington.

Planted as forests for timber production, ten million trees would reforest a mere ten or fifteen thousand acres and would likely fail in their purpose of commemoration; planted singly or in small groves for recreation they would be more constantly in the eyes and minds of the people and would automatically bring to mind the utility of trees.

The Association's program is of interest to foresters, especially insofar as they can lend encouragement to the establishment of wood-producing forests by towns and states for commemorating Washington's birth. It would, however, be out of line with the purpose of the

celebration and a questionable asset to forestry to connect with the memorial planting its need for helping avert an oft-predicted shortage of timber. Such a slogan would be a miscarriage of the aims of the commemoration effort. The Association is encouraging the planting of town forests and the extension of other public timber production forests, but such encouragement and planting should be connected only with the idea of commemorating the birth of a great American and not with the threat of a timber shortage. The two are separate and distinct.

Let us plant trees to commemorate Washington's birth—single trees, groves, and forests,—but let them be solely *commemoration* trees or forests. The trees themselves will do whatever else might be needed.

THE MANAGEMENT OF SHORTLEAF AND LOBLOLLY PINE FOR SAWTIMBER[1]

By A. E. WACKERMAN

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With the authority and experience of actual practice the author outlines a continuous-yield program for a partially cut-over forest property of large size and gives, as well, the steps the forest manager must follow to put the program into execution. This is a contribution of outstanding merit and it is refreshing for its practicality and for its systematic treatment of the subject. The author does not theorize on an imaginary property. The one he uses as an example for growth possibilities is the one whose forestry program he is directing.

GOOD forest management for continuous yield means more than fire protection, the application of essential silvicultural methods, and the regulation of the cut; it means, in addition, the profitable handling of the forest property. All commercial lumbering operations presumably are profitable and they all represent some form of forest management, from the crude cutting of virgin timber with no thought of future production to the most refined forms of European regulation. But unless forest management provides for future production it is not good forest management. Unfortunately most of our commercial forest management does not adequately provide for a future cut.

This paper is concerned not with the crude form which hardly deserves the term of management at all nor with the ultra-refined forms that as yet have not been attained in this country, but with a practical plan of continuous timber yields from a typical forest property in the shortleaf-loblolly type of the South. Since most of our forest management has been of the crude form, practical continuous-yield management must be attained by converting such management into the continuous type. To be practical our plan must be profitable; if it is not, we are defeated at the start.

For an example, let us assume a 100,000-acre forest in a typical shortleaf-loblolly pine type of the Southern Coastal Plain. The topography will be level to undulating with intermittent drainage on the uplands. The virgin timber will be a mixture of pine and hardwoods with pine greatly predominating. The stand of timber on the cutover lands will vary greatly due to different degrees of utilization at different periods in the past and to the severity and frequency of fires in different localities. Generally speaking the cutover lands will have a fair to good stand of young merchantable timber and a good stand of seedlings, saplings, and poles, although there will be

[1]Presented at 30th annual meeting of the Society of American Foresters, at Washington, D. C., December 29-31, 1930.

some areas that are pretty well depleted.

If typical, the forest will be at least three-quarters cut over so it will have about 25,000 acres in virgin timber and 75,000 acres cut over; also, a mill that obviously has too great a capacity for continuous production. In this instance, let us assume that the mill cuts 100,000 board feet a day of pine and that a small hardwood mill cuts 35,000 board feet a day, making a total cut of 135,000 board feet a day or a yearly cut of 40,000,000 board feet. From cruising estimates and from past experience it is known that the virgin timber averages about 8,000 board feet per acre, Doyle scale, of which some 10 to 15 per cent is hardwood, mostly oak. Good virgin stands will often have as much as 15,000 board feet per acre, but frequent openings and thin stands bring down the average. With 25,000 acres of uncut timber the total virgin stand would amount to 200,000,000 board feet and it is evident that in 5 years time the mill will be cut out of virgin timber.

The cutover lands, however, are an unknown quantity, although it is apparent from casual observations and occasional items of experience that they are too good to abandon. In fact, they show up so well that the stockholders of the company operating the forest have become interested in forest management for continuous production and it has been decided to put the property on such basis if possible. The first step, then, is to find out whether or not continuous-yield management is possible on this forest.

By the usual means of a forest survey and current growth studies the present amount of timber and the productiveness of the forest are determined. Of this forest it is shown that the virgin timber is growing only enough to offset losses from decay and windfall, therefore no net increase is taking place. On the cutover lands the stand of merchantable timber averages 2,000 board feet of pine and 500 board feet of hardwood per acre, or a total stand per acre of 2,500 board feet. Growth is found to be 200 board feet per acre per year of pine and 20 board feet per acre per year of hardwood, making a total annual growth per acre of 220 board feet. This is a total growth for the forest of 15,000,000 board feet of pine and 1,500,000 board feet of hardwood on the 75,000 acres of second growth.

Since the mills cut 30,000,000 board feet of pine and 10,000,000 board feet of hardwood yearly, it is evident that the cut is far too great for continuous production. The cut will be too large even after the remaining 25,000 acres of virgin timber have been cut and the annual growth increased, because of the larger area of second-growth, to 20,000,000 board feet of pine and 2,000,000 board feet of hardwood. Because the average stand of merchantable timber on the cutover land is only 2,500 board feet of pine and hardwood per acre, more than 5 years of growth is needed to build up the second-growth forest capital to the point where economical logging can take place. Generally speaking, the older cutover lands have more timber than the more recent cutover lands, yet fires have been so numerous and uncontrolled in the past and some of the earlier utilization was so close that the difference between them

is not so marked as might be imagined. Good, medium and poor stands are found throughout the entire cutover area and it would be difficult to separate them for logging operations which must be concentrated, more or less, in a definite block rather than scattered widely around among the heavier stands. Consequently, the average stand per acre for the entire forest gives a fair idea of what the cut per acre at the beginning of the recut would be.

If the sawmill life in the virgin timber could be extended to 10 years instead of 5 years, the pine stand on the cutover land would increase to 4,000 board feet per acre, or double its present volume. The hardwood stand also would increase from 500 board feet to 700 board feet per acre making a total of 4,700 board feet per acre as compared to the present total stand of 2,500 board feet per acre.

A stand of 4,700 board feet per acre should justify logging for a second-cut. By reducing the mill capacity to growth capacity it would be necessary to cut over some 4,900 acres yearly at the beginning of the second time around after allowing for 200 board feet per acre to be left as seed trees. If the stand remained the same for the duration of the second-cut it would take 20 years to recut the entire 100,000 acres. But we know that the area ahead of the recut will still be growing at the rate of at least 220 board feet per acre per year and that the stand per acre will be heavier each year and, as a consequence, a smaller acreage will be needed to supply the mill. So it is certain to take longer than 20 years to make the second-cut if the sawmill requirements remain the same.

If growth continues only as at present, at the end of 20 years it will have built up an average stand of 6,900 board feet per acre and, with the same output, only 3,190 acres would need to be cut the last year as compared to 4,900 acres the first year. The average for the recut, then, would be some 4,000 acres per year, indicating a 25-year cutting cycle. However, as time goes on growth should increase and still further prolong the life of the second-cut.

These are preliminary calculations for the sole purpose of determining if forest management for continuous yield is possible and, if so, upon the size of sawmill needed for the second time around. It is evident from this analysis that a cut of 20,000,000 board feet of pine and hardwood is all that the forest will stand for the next 20 years—10 years more of virgin and the first 10 years of the second-cut. If we anticipate increased or greater future growth during the second time around and start off with a larger capacity than indicated, too much acreage will be cut over at the beginning and the growth will not be found.

It is apparent, therefore, that continuous yield is possible if the output of the sawmill or, more particularly, the output of sawlogs from the forest can be reduced enough to increase the life of the virgin cut to 10 years and to maintain this revised schedule of production during the first 10 years of the recut.

Such a reduction in sawmill output, however, means severe financial difficulties for the company due to increased overhead, increased logging costs, and greater sawmilling costs on account of

less volume, incomplete use of power resources, and the like. A temporary solution is to acquire additional stumpage, if possible, and run at maximum capacity for a few years longer, using the acquired stumpage to make up the deficit between the allowable cut from the forest and the mill capacity.

Sooner or later the real problem must be solved and that is to operate continuously within the cut permitted by the continuous yield program. With the sawlog output of the forest limited the solution lies in utilizing completely the timber that is cut to produce the required amount of sawlogs. At least 15 per cent of the volume of the trees cut for sawlogs is left in the woods in the form of tops and crooked sections. This is a waste of good wood which if used as a raw material for an additional industry would help materially to solve the operating problems of reduced sawlog output. In fact, it is essential that closer utilization than a sawmill affords shall be practiced if the continuous yield program is to succeed.

The manufacture of pulp and paper requires just this form of raw material and from sample determinations it is found that for every 4,000 board feet of sawlogs produced, 1 cord of good pulpwood is left rotting in the woods, to say nothing of the sawmill refuse. Under the proposed cutting schedule of 20,000,000 board feet a year, of which pine makes up 18,000,000 board feet and hardwood 2,000,000 board feet, there is rotting in the woods 4,500 cords of good pulpwood. This is a daily supply of 15 cords for 300 days. Added to the topwood cords, there would be an additional amount from unmerchantable trees broken or thrown in logging, and from defective standing trees. Altogether, the daily production during the life of the virgin timber should be at least 20 to 25 cords of wood a day, which would be a fair start towards the requirements of a pulp and paper plant with a capacity of, say, 75 cords a day.

During the early life of a pulp and paper plant, pulpwood is almost invariably cheap; so cheap, in fact, that most mills buy wood instead of cutting their own timber. It would be good business in this case to use from the forest only the woods waste and such of the sawmill refuse that could profitably be utilized, and make up the deficit by outside purchase. A careful investigation in any of the shortleaf pine areas of the Coastal Plain would more than likely show that the supply of pulpwood on the market would be entirely sufficient for a paper-mill life of at least ten years, which would postpone pulpwood cutting, except salvage cutting, until the beginning of the second cut.

Operating the pulp and paper mill for the next 10 years on salvage wood and purchased wood would be conserving the forest's pulpwood capital for the recut when it will be more urgently needed.

Let us assume that the forest survey showed an average stand of 3 cords per acre, not including sawlog trees, and that growth is one-tenth of a cord per acre per year. If the second growth is not touched for 10 years, or until the second-cut, the stand at the beginning will be 4 cords per acre, plus 1 cord from the tops of the sawlog trees, making available 5 cords of wood per acre for pulp. It may seem that one-tenth

of a cord per acre a year is small growth but it must be remembered that growth is taking trees out of the pulpwood class and into the sawlog class nearly as fast as it is bringing them into it from seedlings.

To supply the sawmill during the recut it will be necessary to cut over 4,900 acres yearly at the start and from this area, at 5 cords per acre, 24,500 cords of pulpwood would be produced, or more than the 22,500 cords required. This would leave standing behind logging an average of about one-half a cord per acre, which together with the 200 board feet of seed trees, would leave a fair nucleus for the third time around. During the first 10 years of the recut, growth will add at least another cord of wood to the uncut acres, but since the area cut over will be less on account of the heavier stand of saw timber per acre, the number of cords produced will be only 22,000, which about meets the paper mill requirements. Likewise, at the end of 20 years the production would still be about the same, in spite of growth, because the acreage cut over for saw logs would be still further reduced. But during the next 10 or 15 years a great deal of pulpwood timber will enter the stands on the cutover lands. With good fire protection, natural reproduction takes place quickly and growth is rapid, so, in all probability, there will be a great many more cords of wood on the areas to be cut over than is here indicated. But to be conservative these probable cords will not be counted until they are there. The production schedule can then be altered accordingly.

By that time changes in markets and in wood products from the forest may change considerable the relative importance of lumber and paper production and it may be advisable to increase paper production or other forms of wood cellulose production and only manufacture the high grade sawlogs into lumber; their quantity being regulated by their occurrence on the area cut over for pulp or cellulose wood. So no detailed plans need to be drawn up this far in advance as long as there will be more timber than needed for the present schedule of operations. Any alterations in the future will certainly be based on the productiveness of the forest.

This analysis has shown, so far, that continuous production of lumber and paper is possible from this forest from a stand and growth viewpoint, as well as from a financial viewpoint because the establishment of a pulp and paper mill, if its operation were profitable would offset the operating handicaps of the reduction in sawmill capacity.

The next step in putting our forest under continuous-yield management is for the directors and stockholders definitely to adopt a program of forest management and utilization such as we have discussed. Let us assume that, being good business men with financial resources, they do adopt the program of reduced sawlog output from the forest, and the inauguration of pulp and paper production.

It is essential to the success of the program that this policy be definitely adopted because if it is not, changes in the utilization schedule may very easily destroy all hopes for continuous yield. Merely establishing a pulp and paper

plant in conjunction with a sawmill would not bring about continuous yield, but would, in all probability, bring about a more rapid and more thorough depletion of the property.

Forest management for continuous yield is dependent upon good and complete utilization but such good and complete utilization must come after forest management plans have been drawn up and a definite policy adopted. If they come before, the forest will probably be gobbled up—lock, stock and barrel. One operation in the South, a sawmill and a pulpmill, leaves the forest absolutely cleaned up with no hope of a future cut save by planting, which is expensive forest management. On the other hand, if the principles of continuous yield are laid down first, such utilization would be ideal.

A continuous-yield program for the forest has been outlined, but the forest manager's job has just begun. True, the virgin cut has been extended to 10 years, and the sawmill capacity for the second time around has been reduced to meet the annual growth figure, and a pulp and paper plant has been built to provide for complete utilization of woods waste and to overcome the financial difficulties of a reduced sawmill output, but a great deal remains to be done.

To make the property productive it is necessary to keep the cutover lands producing and the first essential is to obtain reproduction after logging. Since natural reproduction is easily obtained in the shortleaf-loblolly timber types, the seed tree method is the best to use. At least two, and more if needed, good vigorous and wind-firm trees from 13 inches to 18 inches d. b. h. should be left per acre to insure good reproduction. This is in addition to the stand of undersized trees left behind logging. Eventually these trees would produce seed, but to insure reproduction at an early date it is advisable to leave trees already in a seed bearing condition. With proper care in their selection, but little loss from windfall will occur.

Since a second-cut and even a third-cut are a part of the program, trees of marginal value must not be cut. It is always good lumbering practice to leave trees that do not pay their way through the mill, but when the plan is to "cut out and get out," the temptation to take everything that will make a log, no matter how small, is so great that logs too small to yield any profit are taken, and as a rule the cutting limits even go below the margin of profit and get into the loss class. But when the plan is to log again on the same area there is no incentive to take out now trees and logs that are too small. In fact, the incentive is to leave them because they will be the basis of the next cut and by that time they will have increased greatly in size and value.

It is a striking fact that practically all studies of the cost of logging and milling logs, regardless of locality, show conclusively that trees below 13 inches d. b. h. do not pay their way; that maximum present profits are secured when trees below this size are not cut. This has been shown to be true in the shortleaf-loblolly forests of the South. Trees below 13 inches d. b. h. should be left standing, unless defective, in which case they should be cut into pulpwood.

Fortunately the virgin shortleaf-lob-

lolly forests of the South are largely all-aged stands made up of trees of all sizes so that when the merchantable trees 13 inches d. b. h. and larger are cut, a good stand of young growth timber remains. With this young timber already on the ground and with seed trees to provide for the prompt reproduction of blank areas the cutover lands soon will be in a productive condition.

While pulpwood will be taken out along with the logs during the next 10 years of virgin cut it is not coming from the trees too small for logs unless they are infirm, defective, or damaged in logging. Cheap pulpwood in the open market will make it unnecessary to cut the forest capital for the first 10 years so the trees too small for logs are left for the recut.

If it has not already been done, strict fire protection must be put into effect. The plans that have just been discussed are based on good fire protection for the property and if this is not provided the plans are worthless. It is no small task to keep fires out of a forest property in the South, but it can be done. An efficient and well organized forestry field force can not only take care of fire protection but other timber and land matters as well. The urgent need for fire protection is to allow the seed trees to restock all blank areas before the second cut removes the large, seed bearing trees. If this is not accomplished the hope for future reproduction is remote.

Along with all these current activities plans must be perfected for the second cut because then the whole woods program changes. Cutting areas must be located and the amount of pine, hardwood, and pulpwood that will come from each must be known. The kind of a cutting system that is best must also be determined, whether or not the seed tree method will still be the best method or whether some other method should be used, such as the strip method where narrow strips are cut clean and between them a fair stand is left to seed the clean cut strips. At any rate, handling second-growth timber will be different from handling virgin timber and methods must be decided upon. The mills must be supplied with the wood needed and the forest must be left in good shape.

While this is going on there should also be a gradual training of the forestry field force not only in fire fighting but in land line work, timber estimating, public relations, elementary timber management and in marking for thinnings, seed trees, and improvement cutting because as time goes on these activities will be practiced more generally.

Now if all these things can be done and a profit made, good forest management for continuous yield can be practiced. For the remainder of the virgin cut, and for the first ten years of the recut, costs and income will go on about as before in spite of a reduced sawmill output because of the pulp and paper plant that operates on woods waste and cheap purchased pulpwood and bears its share of overhead and provides tonnage for the logging department. The only additional costs are for the forestry department field work and technical administration.

To offset this cost of from $15,000 or $20,000 a year is an annual accretion

of stumpage, through growth, amounting to 22,000,000 board feet and 10,000 cords of wood (equivalent to 5,000,000 board feet), making a total growth of 27,000,000 board feet. This only costs an additional $20,000 paid out for fire protection, timber expense, and technical administration, so it is equivalent to purchasing stumpage at 50 cents per thousand board feet, assuming that the manufacturing operation from logging to the box car bears all other costs as it does at present.

Compound interest plays no havoc with this operation because it does not apply. This is no investment or speculative forest where money is spent in planting trees or in protecting reproduction with no income expected for a number of years. This is a going concern, forest management included, and expenditures for forest management are paid off currently from income as a part of production or operating costs.

After the second time around only a scattering stand of seed trees and poles will be left because both the sawlog stand and the pulpwood stand will be cut, but advance reproduction will be well established and the forest will be left in good shape for new growth. Fire protection will keep losses to a minimum and in a very few years the area behind the second cut should be a dense stand of seedlings and saplings. If it takes 25 or 30 years to make the second-cut, as seems likely, the oldest cutover lands at the end of that time should be well stocked to stands of pine varying from 30 to 50 years old. These stands would be ready for the third cut and should contain a considerable volume of sawlogs and pulpwood. If they have only one-third as much volume as given by the Southern Forest Experiment Station for stands of this age on average sites they would have from 4,000 to 5,000 board feet per acre, which would more than carry the sawmill and in addition they would have a heavy stand of cords of pulpwood.

These are the kind of calculations that are needed in establishing continuous yield for a forest under present conditions. We have to take it as we find it and then make the first steps towards sustained yield or continuous production on a trial and error basis. We must have a plan flexible enough to meet changed markets and leave a sufficient margin of safety for unforseen emergencies. We must think clearly and not necessarily be bound by text book formulæ or classical examples. And above all we must work out a plan that is not only practical but reasonably profitable because forestry is not a fetish or a cause or a slogan, but a business and it must yield dividends.

NOTES ON PRIVATE FORESTRY IN THE LAKE STATES[1]

By RUSSELL WATSON

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Growing trees is the business of the forester; timber conversion is the business of the lumberman. There is apparently not enough money in saw-milling in the Lake States region to attract the larger sawmill operators to consider sustained forest yield; the pulpmill operators do consider it seriously. The project of commercial timber growing, upon which the author and his associates is engaged, for the production of the forest products for the open market is suggestive of possibilities for other foresters.

THE forester who is interested in the practice of forestry in the Lake States and who is working under the old definition of Professor Roth, namely, "Forestry is the building up, the putting in order and keeping in order, of a forest business," finds the forests, markets, taxes, economic conditions and general environment both to his liking and to his disadvantage. His job is to raise forest products, and to sell them for a sum above the cost of raising and marketing. In short, if he wishes to persist in business he has got to make money unless he has a wealthy company behind him which will pay the bills for purposes not solely those of forestry. We will assume that he has no such Santa Claus.

One would think, off hand, that it would not be difficult to attract lumber companies into the practice of timber growing. Some of them unquestionably are wealthy; many are simple family affairs with no responsibilities other than to their employes; they are in the business of using timber and the forester's job is to grow it. Apparently the two should work together easily. But such most decidedly is not the case; and there is not a single instance, so far as I know, in our territory of any lumber company which saws logs and markets lumber for a living, that is very seriously figuring on much, if any, perpetual forestry operation to supply its mills. The reasons, when you come to think of it, are perfectly simple! (1) there isn't enough money in the lumber business today to bring the urge to carry on with any great optimism, with or without forestry; (2) the mills are mostly geared up to cut around 20,000,000 feet, board measure a year, and this is a lot of logs for any forester to contract to deliver. In fact, it would mean having approximately 100,000 acres of good producing forest and would be a property worth about $2,500,000, supplying about $500,000 worth of logs a year. It would be a major operation. (3) Most of the large mills will be cut out and closed out, according to their own calculations, about 1940. After that time, when the principal supplies of virgin timber are gone, many lum-

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bermen anticipate that the market for northern hardwood lumber and flooring, will suffer a price decline on account of lack of sufficient movement of lumber to keep the market alive. This is just what has happened to white pine in our territory, according to lumbermen.

The only lumber companies which seem destined to persist in the lumber business are the smaller outfits which can start or stop with little loss, which have only a small plant and property overhead expense, and which can move their little plants from place to place as need arises. Such little mills in general are not strong enough financially to carry much of a forestry operation; they may, in fact, however, become a desirable accessory to a vigorous timber growing company.

As possibilities for the practice of forestry in our region it is probable that the present large lumber companies may be cancelled from the list of prospects. This conclusion may be logically arrived at as above, and it is amply borne out by definite statements from the heads of a number of the largest and strongest lumber companies.

The conclusions arrived at by the Lake States Forest Experiment Station in coöperation with the Forest Products Laboratory that the handling of small logs is done at a money loss and that, therefore, only large-sized timber should be cut and the smaller left for a future growth, is generally well recognized by the lumbermen themselves as being a truism. But when one can sell cordwood and ties from the smaller trees, thereby making a few dollars extra, the average lumberman is inclined to do it. If the State or Federal governments could so plan their forest acquisition programs as to cover areas being lumbered and thus would buy forests left after selective logging, at a price of even $5.00 to $10.00 an acre, I believe a great many lumbermen would be tempted, in our region, to engage in partial cuttings.

Since the lumber companies are the principal users of hardwood timber, the conclusion seems inevitable that sustained yield in the northern hardwoods will not be carried on for the purpose of growing saw-logs for saw-mills. There certainly will be exceptions to this general conclusion, perhaps for veneer and special uses, but it is noted here as showing an apparent inevitable trend.

The next large group which might be interested in the production of forest products is composed of the pulp and paper mills. There is no question that many of the stronger of these companies are quietly and persistently acquiring large holdings of the better stands of mature and immature pulp species. One company with which I am familiar makes a practice of picking up tax titles to thousands of acres each year of the better quality of the cut-over unburned swamps for the sole purpose apparently of assuring a future supply of raw material. The same is true of other concerns, and indeed several companies have recently added technical foresters to their field forces, evidently with the intent of developing the technical side of forest production

Conditions with the paper companies are much different from those of the sawmills. The paper companies in gen-

eral are making money and figure that they will keep on making money if they can keep on running. The companies usually occupy strategic and highly valuable locations on water power sites; their capital investment in plant and equipment is large and is adapted to long time amortization charges. Also, and this is an interesting silvicultural phase, the pulp plant deals with species which grow in swamps or wet places which are naturally fire resistent, they reproduce themselves densely in uneven-aged stands, they are aggressive growers and they are marketable at a relatively early age. The Lake States swamp forest of good site is by long odds the forester's best bet.

Further, the average pulp and paper executive has implicit faith in the future marketability of his product, and this faith brings faith in the future value of the raw material which he uses.

I should hazard a guess that by 1940 the paper and pulp companies (*i. e.*, users of wood fibre) in our region will have, under what might be termed sustained annual yield, a matter of from 500,000 or 1,000,000 acres. The forestry practice will doubtless not be of the very best, nor of the kind the foresters will want. It will certainly be dominated by the mechanical requirements of lumbering operations and plant usage. But there will be a definite comprehension of the value of land and forest for the production of forest products. Indeed, I should say that within even the present decade there will come faint glimmerings of commercial timber cutting by these companies which will have the silvicultural objective of development of the better species and a good stand of trees.

As I feel woefully sure that the sawmill operators will not attempt much along sustained yield, I am optimistically satisfied that the pulp and paper plants will steadily build up permanent producing forests contingent to their plants.

Besides the specialized field above mentioned, however, the possibilities of private forestry in our region are at present rather good. That is, a forestry company whose purpose is the acquisition of forested lands; the marketing of the products on the open market to the highest bidder, and the building up of a growing producing forest, finds in the Lake States a fairly fertile field for its activities.

The reasons lie mainly in the favorable markets and in numerous good forest "buys" now apparent to the forester.

There are many wood-using companies which demand a continuous supply of forest products and which have neither the financial resources, knowledge, nor (more particularly) the aptitude or bent for the practice of forestry. Many of such companies do not anticipate an early decline of the markets for their products. Such for example are the manufacturers of bowling pin, shoe lasts, handle stock, tubs and pails, mine props, excelsior, posts, poles, ties and wood pulp or fibre. In short, as the cheap supplies of virgin timber become progressively depleted, it seems as obvious to establish wood-growing businesses as to maintain wood-using enterprises.

As we work deeper into wood utiliza-

tion, it seems to us that a well located forest property, which has a good growth of several species, should have no trouble finding markets for its products, either now or hereafter. In fact, an active salesman will surprise one with the number and variety of plants that he will locate and which use raw forest products. We have little fear of lack of future markets for general wood products.

Happily, also, the forest fire trouble, especially in Michigan, is rapidly being brought under fairly adequate control. The past season was a bad one, yet relatively very little damage was done. The general good attitude of care with fire by lumbermen, settlers, and campers, which is now everywhere apparent, is a powerful factor in this situation. As a rule the forester can raise his forest without much more fear from serious losses from fire than has the owner of virgin timber. Forest tax laws, also, are very favorable, and as a matter of fact we have not had much trouble inducing local tax boards into giving us a fair "break" in the taxes on lands which we put under continuous forest operations.

The most interesting items, however, connected with private forestry development, are the forestry possibilities and characteristics of the forest itself. If one were to consider the northern forest as a unit, one would find a hopeless situation as to age classes from the point of view of sustained annual yield. The forest is really composed of trees of two age classes, namely, the over-mature in the virgin forest which ought to be cut, and the immature saplings which cannot be cut. There is certain to be a time gap of two or three decades between the virtual finish of the virgin forests and the coming into merchantable production on a large scale of the natural and planted second growth.

The forest, however, grows surprisingly fast, and we have found a number of forest properties, both of hardwood and of swamp forests, which were cut over but not burned from ten to twenty years ago, which have always been considered as cut over lands but which have a remarkably large volume of presently marketable timber on them. We are able to purchase many of such stands at cut-over land prices. In fact, in our own practice, we do not consider a purchase desirable or worth while unless there is enough marketable timber mingled with the second growth to enable us to liquidate on it shortly to pay back the cost of the property, leaving us with the young growing forest at no cost.

As a matter of fact, I doubt that the private forester, building up a forest, and expecting to make money from the sale of forest products on the general market, dare take a chance on very young trees which will not be merchantable for perhaps twenty-five or thirty years. He dare not do it, I think, unless he really gets the property for nothing and carries it on his books as an asset of very low value. If there were a number of companies engaged in the business of growing forest crops, and young forests had a well recognized commercial value in exchange, then one would feel safer about taking a chance on a long term proposition. If such were true, then the owners would feel that if the company chanced into financial distress, as many have this year, some form of assistance

through using the young forest perhaps as collateral, could be arranged. Every company knows the value, of course, of liquid assets, either to tide over lean times or to take advantage of toothsome bargains when they appear. But as things stand now a young forest is a frozen asset which must be carried for years if its potentialities are to be realized upon.

Such a forest situation, while it has its disadvantages, indicates the public regard for young forests, and makes for opportunities for the discerning forest buyer.

Our own firm, as foresters in the private forestry business and pretty thoroughly experienced in commercial woods practice, has the utmost confidence in the financial feasibility of the practice of timber growing as a commercial private venture. Our experience runs over several years, and our convictions are more firmly established than ever. In fact, this work, which developed as a side line to our professional consulting forestry work, now absorbs most of our time and energy. To be sure, one must not wax too enthusiastic and make rash purchases based on only casual study of the property or one is likely to be left holding pretty but useless woods. But the general proposition seems to us so practical and worthwhile that we are now indeed extending our operations and by this means we hope to make true the dream and the goal of all foresters for an independent large-scale commercial forestry operation.

The principal obstacle is the psychological one. We have no (or very, very few) foresters who go forth from college and start in growing timber like a student of agriculture going on the farm. They don't seem to think of doing that. And yet there are literally boundless possibilities in this field for a young man who will locate in a small town and start in with the acquisition of forest lands and the growing of timber, perhaps with his own little wood-using plant to go with it. It is an obviously simple thing to do; it offers a lot more fun and is more profitable than most forester's jobs. The forester has, for forty years, been telling private timberland owners what they ought to do; maybe the time is ripe to try doing the job ourselves. After all, the growing of trees is our business, not the lumberman's.

THE ECONOMIC APPROACH TO FOREST MANAGEMENT[1]

By JULIAN E. ROTHERY

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Timber ownership and conversion call for careful analysis and valuation to give them a sound business foundation. The value of the forest will dictate the method of its financial and technical handling. Any one of the three fundamental factors of composition, location and local political conditions may remove the forest property from the range of present economic value. The author discusses a number of other facts to be considered in determining the value of a forest property.

THE FIRST essential in the management of forest lands for a continuous supply, is to secure a large enough forest area to furnish, for at least a rotation period, the timber required for the conversion plant.

It is not enough to apply silvicultural methods to a tract unless there is an ample timber reserve for a rotation and sufficient producing capacity to grow the amounts sought in the future.

In this connection it is interesting to note that the Province of Quebec, in establishing forest reserves, has recently considered that a rotation for spruce is 75 years. For commercial purposes a reserve of standing timber in that region amounting to fifty times the annual cut should be reasonably adequate, when there is taken into account the young growth and restocking areas that have a low volume content today but which will mature during the rotation period.

Numerous large paper mills consume from 200,000 to 300,000 cords a year. This means, as the first requisite for a sustained yield, a supply of from 10,000,000 to 15,000,000 cords of wood, involving perhaps several million acres of land.

In considering forest areas as extensive as this, the single most important question to be asked, and surely the first question, is: What is the value of such an area? In other words, the basis of management first requires a thorough study of all the fundamental factors of value; it is a curious commentary that this phase of forest management is the least discussed in our forest literature, though it is by far the most important and pressing of all questions.

Management, then, stands squarely on a clear realization of timberland value, possibly for purchase, or, if already purchased, possibly for a correct distribution to capital account; in any case it is the financial foundation upon which the cost of protection and silvicultural measures must be predicated. Before we can intelligently spend two cents an acre for fire protection or ten cents a cord on the annual cut for forestry, the basic value in that acre or in that cord must be fully analyzed and appreciated.

To begin with, the economic impor-

[1] Presented at 30th annual meeting, Society of American Foresters, Washington, D. C., December 28-31, 1930.

tance of any timberlands must rest on their relation to human needs and how their various products can be woven into the fabric of our daily life. From this starting point any one of three factors, namely, the mere species of trees, the geographical location of the forest, or the political conditions in the country in which it is situated, may be a controlling one; a tropical forest of unknown woods, an excellent stand of spruce on the Yukon flats, or a forest of mahogany in an unstable South American republic, are practically valueless today, as they do not offer a fairly immediate chance of filling an economic need. Capital will not flow to their development, and management will not be possible.

As political stability is the foundation for modern activities, timberland values, even under a stable government are affected, drastically sometimes, by political conditions. For instance, logs in Vancouver Harbor, B. C., are worth one price, while across the American border a few miles to the south, the same species and grades are worth more, and between adjacent provinces of Canada a variation of values is frequent, even where the forests are practically identical in all other respects and bordering on the same stream. The causes of this are frequently complicated, depending on such matters as the nature of land tenure, taxes of various kinds, embargoes, tariffs, scaling practices and governmental laws and regulations.

These three major factors of composition, location and political status may usually be readily determined and any one of them maybe found to be so important as to remove a property from the range of economic value today. Most timberlands, in the United States today meet these three requirements, though Canada has many thousands of square miles of good pulpwood species so remote that they still remain in possession of the Crown because nobody considers them available for use and therefore not valuable enough to apply for.

Considering, however, that the forest area to be studied has met these three tests, then the methods of valuation are next to be considered. Probably most timber owners first thought seriously of timber values when the Bureau of Internal Revenue allowed them to deplete their capital for income tax purposes on the basis of stumpage value on March 1, 1913, as determined by the untrammelled purchase and sale of comparable timber. While it may have seemed a tremendous problem to determine the value of standing timber all over the United States, yet within the various forest regions much data was obtained as to actual bona fide sales, and when the values per unit or per thousand were adjusted to a comparable basis and plotted and graphs drawn, they showed surprisingly close and uniform values.

What others have paid for timber in the immediate past is considered a useful measuring stick to determine what one can pay for a forest in the immediate present. However, such a standard is very limited and general, for by rigidly adhering to it two mistakes can be made: a purchaser can pay too much, or he might refuse to buy a highly priced forest which would be the best buy in the world for his particular needs. In explanation of this it must be borne in mind that standing timber does not always increase in value or even hold its

own level. New regions, other species and even substitute materials enter the market to replace certain species in certain regions, particularly where the supplies are low and prices should be high. Thus we have seen the white pine in the northeast fall in value within the last ten years, due to competition with different western pines and with the fibre products which are replacing lumber in the box industry.

High stumpage values are realized only over a certain period of production from a forest region. Low stumpage values are usually the order when exploitation begins, and they steadily increase during the exploitation until they reach a high figure, but as the high value is reached for the last of the standing timber, competing species, new regions, substitute materials, or all three, often unite to replace the older product, arresting the curve of increasing value and often depressing it.

Likewise, purchase and sale prices may fail to tell how much may be advantageously paid for stumpage, because the intrinsic or replacement value of such stumpage may be far above the price indicated by such purchase and sale data. For instance, a sales price of $2.00 a thousand may be determined as average in a certain general territory, but due to the advantageous location of a specific block of timber in relation to the converting point, it might well be worth $4.00 a thousand. A buyer could afford to pay it and a seller intelligently claim this value because to replace the stumpage from any other tract might readily cost $5.00. Many a good deal has been lost to a purchaser because he could not quite bring himself to the point of paying more than the "going price" when a clear analysis would have shown that even at double the "going price" the timber was still cheap for him.

Even a close study which definitely proves that certain timber held, let us assume, at $2.00 a thousand, and has a margin of profit of $2.00 is not sufficient, for it may readily be that a competitor can purchase similar timber for $.50 and under the same conditions have a $3.50 margin of profit. In this case if the margin of profit should shrink $2.00 the first buyer would go bankrupt, while the other would still make $1.50.

To avoid the limitations of such rule-of-thumb methods and blind adherence to a "going price," the valuation study should be based on every essential physical factor concerning the forest, the ground on which it stands and the social, industrial and economic factors of the region. Such a study must rate the region under consideration in respect to adjacent regions and compare these regions with more remote territories and different forest species which might compete in the future.

A complete study of the entire cost of converting the standing timber into the merchantable products required in our economic life and the probable selling prices of those products in wide markets over a long term of years is the safest basis of measuring the intrinsic worth of timberlands. This total conversion value, after proper allowance for capital investment, carrying charges, risks, competition of other manufacturers, species and regions and obsolescence of species and products, is also the most difficult and intricate.

Basic Factors of a Valuation Survey

Below are given some of the basic factors which must be covered in such a valuation survey. No attempt is made to go into details concerning them, but many are subjects which could well receive exhaustive study by highly trained men, but it is doubtful if they have received the study they warrant and which members of the Society could give them, with profit to themselves, the profession and the forest industries.

A. Raw materials data.
   1. Location, area and geographical conditions.
   2. Topography and local accessibility.
   3. Forest history.
   4. Timber.
   5. Forest conditions.
   6. Logging costs.

B. Industrial data.
   1. Economic and social factors.
   2. Industrial factors.

C. Business data.
   1. Production costs.
   2. Market studies.
   3. Sales expectations and gross margin of profit.

D. Appraisal data.
   1. Conversion value.
   2. Specific or intrinsic value.
   3. Supplementary values.
   4. Loan value.
   5. Purchase or sale price—nature and terms.

RAW MATERIAL DATA

1. With reference to the first factor, it is interesting to realize that mere area determination of several thousand square miles may require geodetic computations and projection methods which would have been considered unnecessary even a few years ago. Geographical conditions and the location of the mill in reference to the market offer a wide and important field of study. Such conditions may be divided into two branches, those that are basic and those which can at least be partially mitigated. Under the former come climatic conditions and features such as short period of navigation, an item which tends to increase the cost of production and lower values, while under the latter come such questions as general accessibility, which with improved communication facilities is being constantly changed. The shape of a forest area may basically affect its value. A long, narrow strip extending back from the outlet would represent long average transportation from the center of the timber. A thin belt bordering the sea and draining to it by many streams would require numerous points of development and operation with attendant expenses. A circular tract or basin, however, would contain the greatest area within a minimum transportation distance, and if it drained to a single outlet would represent very favorable conditions. A checkerboard of blocks, widely scattered, might have but little worth.

2. Under topographic features and local accessibility come a host of more detailed but still interesting factors, such as size and capacity of rivers for driving, harbors and holding grounds where

the wood may be boomed, reservoirs, stream conditions, feasibility of rail or motor road construction which salvage operations might require very quickly, soil and site, contour of the country, as well as many minor factors, such as rock outcrops, cross canyons, dry washes, gullied out stream beds, swamps, boulders, etc. Topography and local accessibility directly affects transportation of logs and the value of the stumpage.

3. Forest history is important and often gives a clue to past successes and failures. It assists in picturing general conditions, both physical and economic, while such points as fire hazards, mining developments and recreational value, may be of major importance.

4. In regard to timber, it is no longer adequate to merely determine the amount and quality of species. The amount of timber is of course one of the first essentials to ascertain, but it must be seen in its true perspective and properly balanced against other conditions. The larger the amount, the longer a given operation will last, and the further in the future will be the final profit and the less it is when discounted to the present. For that reason large tracts rightly sell for less per unit than comparable smaller ones. A large tract however, may be split up into two or three different operating units, supplying different centers of conversion, and in such a case, Euclid to the contrary, the sum of the value of the parts may be more than the value of the original whole. Likewise, small amounts of little value in themselves and representing but a few days or weeks of production in a distant future, may be consolidated into a substantial unit of far more than average value today. Size of timber is an important factor both in determining logging costs and the value of the product. Furthermore, uniformity of size may be equally important. Certain-sized timber can be operated best under certain conditions; usually large timber can be operated more cheaply than small, but a wide dispersion of sizes may not be operated as cheaply by the method and equipment designed for either small or large timber.

5. Forest conditions are the result of the intricate life of the trees composing the stand; foresters for many years have recognized silvicultural types which may be equally important from the operating point of view. For instance, the pure coniferous areas in the spruce regions may border the streams and lakes in the most accessible locations, or they may cover the mountain tops in the most inaccessible situations. A certain per cent of some species or sizes of logs may be necessary to sweeten the average cut of timber to make it more readily usable. If such material is readily at hand in pure stands, well and good. If, however, the same percentage is inaccessible or scattered thinly throughout the entire forest, it may not be operatable in quantities sufficient to meet the requirements. The density of forest or the volume per acre is often a controlling factor. Since logging is largely a transportation problem, the greater the tonnage per acre, the less the unit cost of transporting it. Thus the forest types, both natural and man caused, must be analyzed separately as well as in the aggregate.

Reproduction, growth and a satisfactory distribution of age classes are im-

portant, especially when viewed over a fifty-year period. A light second-growth stand for instance, with a rapid rate of growth, may be more valuable 25 or 30 years from today than a mature or over-mature forest is now; furthermore, such a stand is usually cheaper to buy. An extreme illustration of the importance of growth is found in the southern pine region or parts of the Pacific Coast where timber grows several times as fast as in the Northeast. Here quantities will be produced on far less acreage and in a far shorter rotation period, resulting in a tremendous reduction of carrying charges. Also such an area will produce its crops at less average distance from the converting point with less transportation to that point. Even in the Northeast where accretion is not so rapid, enough second-growth areas have come into bearing to make clear the great financial value of reproduction, thrifty growth and well assorted age classes.

6. There is no industry that presents a wider range of operating conditions and cost than do the forest industries. Methods may be so primitively simple in some regions as to present little variation from the hand work of Colonial days, in other regions they may call for mechanical and civil engineering and even the application of electricity to a very high degree. The work may be organized by the piece, by contract, or by day labor. Operations may be confined to certain sizes and species of trees, or logs of certain lengths, or all sizes, species and lengths, and with different costs in each case. They may be conducted intermittently or continuously, with different costs, and so many are the variations of method and equipment in actual practice that even in the same State one cannot realize the extent of them unless he should chance to hear, let us say, a lumberjack from the Kennebec describing the methods, tools and personal characteristics and ability of some other lumberjack, let us say, from the Penobscot or St. John River.

The amount of the annual cut is, of course, a primary consideration, particularly where the capital investment in timber or improvements is high and annual carrying charges must be borne by annual production. There is a minimum below which it will not suffice to make ends meet and a maximum beyond which it is not economical to force it. Particularly in the delivery of forest products by stream driving is the quantity to be cut on any stream extraordinarily important. There are many cases where the wood on the lower reaches of the larger streams has been cut and disproportionate balances left on headwaters of limited driving capacity. This wood must come out slowly and at an added expense of operation and maintenance of improvements. Thus the average cost of logging a unit may be increased by such miscellaneous operations over and above the cost that a properly planned and balanced operation would indicate.

However, though logging operations have their own peculiarities and intricacies, they are subject to a financial study along the same general principals as are used in the production of steel or the generating of electricity.

INDUSTRIAL DATA

1. Capital, forest or otherwise, is more secure in a region of honest, thrifty and intelligent people, where labor is ample, proficient and law abiding. The collective expression of their intelligence as embodied in the local government may effect timberland values through wise or unwise legislation and taxes. It is interesting that one important timber State with a forest fire problem of unusual magnitude has steadily opposed the simple legislation which would allow the federal government to appropriate coöperative protective funds. In other States these funds and additional moneys have been so intelligently used for so long a period that the fire hazard is in many cases reduced to a remarkable or even negligible degree.

2. General industrial conditions are of increasing importance because all business is changing with kaleidoscopic speed. Not only have we seen the corner grocery yield to the chain store and railroads wince from the competition of the motor truck, but we have seen the cotton stocking give way to rayon and paint supplanted with cellulose lacquers. On the other hand, we have seen fibreboard cut into the lumber uses, cement and steel take the place of frame construction, and forest products as a whole fall in their rate of per capita consumption. As previously mentioned, new species from different and often far distant regions are frequent potential competitors as well as the species from the same region. On the Hudson River boats may pass with cargoes destined for mills formerly supplied from the Adirondack forests; on one ship may be pulpwood from Europe and on another wood pulp from the Pacific.

BUSINESS DATA

1. The cost of delivery of raw material is the first data required in production costs. Next, the conversion charge must be obtained, which, in the case of a paper mill is an intricate and expensive process, dealing with great quantities of low priced material yielding a highly specialized product.

2. Market studies are necessary to determine the trends, uses, possible expansion and competition, and the price fluctuations which may be expected over a period necessarily long from the very nature of the business.

3. Such studies as outlined above give the gross margin of profit to be expected in the venture. The value of the raw material is in direct proportion to this gross margin of profit, but only a fraction of it.

APPRAISAL DATA

1. The gross margin of profit or total conversion value must be carefully weighed in the light of several handicaps in addition to those found in the usual business enterprises. While it is true that the forest can be renewed, it is also true that it is subject to natural hazards of extraordinary proportion through wind, fires and insects, any one of which may rise into major catastrophies and have been known to practically wipe out extensive investments. A paper mill is forced to protect itself with an investment in a timber supply approaching a rotation period, and the interest on this is very heavy. Forest

taxation, often placed on reserves and not on production, is a well recognized burden, so serious as to be the subject of intensive inquiry. In addition, forest ownership, differing from any other form of property, seems to be subject to public and governmental agitation and criticism often tending to the abridgement of rights and to increases in carrying and operating costs and impairment of value. Not only do we encounter these peculiar elements of hazard and financial burden in the raw material supply, but a large paper mill also has its own particular industrial limitations. The cost of such a mill is far greater than the cost of a mill in any other forest industry, and in the relation of value to output is far greater than in many other manufacturing processes. Thus in the automobile industry the value of cars produced in a year may be several times the amount of money represented in the plant and working capital, but a paper mill may require several years of operation before the value of its products would equal such a figure.

2. With these facts in view it is necessary to carefully scrutinize the conversion value of the forest products with an eye to the basic values of timber, the peculiarities of ownership and the manufacturing conditions, in order to obtain a proper ratio of conversion value to intrinsic or specific value. The margin of profit must be large for the turnover is slow, the hazard is high and the forest must pay heavy interest and amortization charges accruing through a distant future.

3. In addition to the intrinsic value there may be an additional or supplementary value of considerable bearing. The acquisition of a certain tract intermingled with other holdings may eliminate a fire danger or a source of trouble and expense in combined operations. It may furnish quick or emergency supplies and prolong the life and lessen the depreciation of expensive plants or improvements, or it may control additional supplies.

4. While care should be taken in an appraisal study of this nature to consider the tract for the purposes of its special utilization, its value for ordinary utilization or in a different market should also be considered. As we must all borrow from the banker, he will want to know how good the security is, not only for this particular utilization but in case the venture fails; he wants to know also for what price it could be liquidated in any market to any purchaser within a reasonably short time—this is the figure on which conservative timber loans are made.

5. If we have the value of stumpage, we can determine fair purchase and sales prices. They are not necessarily the same. The value of a going concern is one thing, and the value of a raw material which can be utilized only after great capital expenditures for production is quite another. One timberland owner tersely expressed his views saying that he made his profit when he bought the tract and that he never made money paying 100 cents for a dollar. Naturally the terms and conditions of payment must vary in accordance with the financial structure and the interest and depletion charges must not outstrip the profits available, particularly in the initial period of development.

This brings up the whole question of

financing the forest industries, which is far beyond the scope of this paper. It is of importance, however, to realize that certain underwriters of timber securities have worked out more flexible terms than the old Serial Bonds which require regular interest and depletion charges every year regardless of whether the market was over-supplied or not.

Conclusion

In conclusion, I realize that this brief paper hardly more than presents the problem and that each of the topics listed could well be made the subject of exhaustive study. Furthermore, I realize that many may disagree with me in my valuation and financial approach to the problem. I believe, however, that this phase is vitally necessary for a sound basis of management as well as business and that it has not received the study and thought to which its importance entitles it.

Values, present and future, determine the expenditure and return of applied forestry measures. Other industries have developed intensive valuation and appraisal methods and technique. The forest industries present a particularly fertile field for this kind of scientific work. It is an old saying, there are so many trees that we cannot see the forest. Perhaps in the maze of discussion regarding governmental policies and forest programs we have failed to see the economic roots of the forest, roots which, as long as our society is organized as it is, are and will be the source of both sound business and sound management.

THE FORESTER'S ROLE IN GAME MANAGEMENT[1]

By ALDO LEOPOLD

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Game management is not receiving the active attention it deserves. Foresters are in a good position to aid the art of game management. They can evolve some mechanism for regulating the "kill"; control environment to enhance game; enlighten governments, private organizations and individuals in game management needs and technique; and study game on the areas they are administering and write up their observations.

IN November of this year there was submitted to the American Game Conference a game policy for the United States. The purpose of this paper is to sketch briefly the rôle of foresters in the execution of that policy, or of any policy based on a similar conception of the game problem.

It will first be necessary to summarize its provisions.

Game Policy Proposed

Game, when regarded as a land crop, falls into three distinct classes, each differing from the others in its characteristics, and hence in its requirements.

1. *Farm game* inhabits land too expensive for the public to own. It is relatively immobile, and thrives on a heavy interspersion of farm crops.

2. *Forest game* inhabits land cheap enough for the public to own. It is more mobile, and tolerates a partial interspersion of farm crops.

3. *Migratory game* inhabits all kinds of land, and is exceedingly mobile.

The policy starts with the assumption that game management on any particular tract of land can be practiced only by its owner or occupant. It consists primarily of modifying the methods of cultivating the primary crop, so as to procure a secondary crop of game.

If this assumption is correct, the question of who shall practice game management is immediately answered. Management of forest and migratory game is a public function, to the extent that their respective habitats can be brought under public ownership. Management of farm game, on the other hand, is a private function. This results in two major jobs:

1. *Acquisition* of forest and migratory game lands.

2. *Extension* of game management methods to farmers.

The policy also deals with the problem of how to compensate the farmer for his game crop, and how to organize research and education so as to develop a management technique, and a personnel competent to apply it.

Acquisition of Game Lands

Before plunging into details, let us

[1]Presented at 30th annual meeting of the Society of American Foresters, Washington, D. C., December 29-31, 1930.

view the proposal to acquire large areas of public game land with such philosophical detachment as we can muster.

The proposal meets with little or no opposition, even from conservative thinkers. This is curious, because it is really a very radical experiment in social engineering. It is even more radical than the acquisition of public forests, because wood is an economic necessity, whereas hunting must be frankly admitted to be a true "luxury," in that it is not needed for mere physical existence, but rather only to round out "the good life." Furthermore, as all foresters know, the movement to acquire public forests derives no small part of its impetus from the fact that those forests will augment "the good life," in addition to producing wood. We need not linger further on these philosophical observations, except to venture the conjecture that fifty years from now the acquisition of public game lands may be recognized as a milestone in the evolution of democratic government.

While the idea of public game lands is acceptable in the abstract, its concrete execution will hardly get very far until the public can be shown that it works. The outstanding present need is for demonstrations.

When one scans a map of the United States, it is apparent that only a very small fraction of the public forests (or other land under public administration) is under deliberate and successful game management.

Real game management has two essentials, 1. the kill must be limited to the increment, and 2. the environment must be controlled to increase the increment and hence the kill.

Some of the national forests, and state forests and public shooting grounds of Pennsylvania, meet the second criterion, but none meet the first. A few national forests, such as the Gila in New Mexico, have evolved coöperative expedients whereby the hunters on each unit of range are registered, checked in and checked out, but the total number of hunters allowed on any unit territory is so far left entirely to chance.

This brings us to the first major contribution which foresters can make to game management. They can evolve some mechanism for regulating the kill on public forests. As pointed out in a previous paper[2] they can also go a great deal farther in controlling environments to enhance the game as well as wood and grass crops.

Extension of Game Management Methods to Farmers

The assertion of the game policy that game management on farms is a private function, rather than a public one, runs directly counter to the actual practice of most states. To put the whole thing in a nutshell, the states are telling the farmer that they will re-stock his farm if he will refrain from posting it against the public. This might be a good formula if it worked, but its failure is increasingly notorious. Expensive farm lands, under the "slick and clean" cropping methods advocated by our agricultural colleges, are losing their woodlots and fencerows, and the cover on their drain-

[2] "Environmental Controls for Game Through Silviculture," *Jour. of Forestry*, March, 1930. "Game Management in the National Forests," *Amer. Forests & Forest Life*, July, 1930.

age channels, to such an extent that they are no longer fit to be planted with game. Moreover, each license, which theoretically entitles the hunter to shoot from a dozen to several hundred head of game, will actually purchase only one head for re-stocking. Furthermore artificial re-stocking emphasizes exotic species, against which fact the non-shooting bird lovers are increasingly inclined to protest. The whole curious muddle reduces itself to the basic fallacy that an absentee (the state) is trying to cultivate a game crop for the farmer, instead of inducing him to cultivate it himself.

Who will undertake to correct this fallacy? Obviously the primary obligation rests on the state game departments. They must reverse their own conception of their own job. They must be brought to see that on farm lands their true function is to foster and regulate private enterprise.

First of all, however, the states themselves must be persuaded that they are now on the wrong track. Who shall persuade them? Volunteer conservation bodies must do the most of it, but experience has shown over and over again that volunteer conservation bodies make very slow progress without the coöperation of paid public officials. One naturally thinks of the U. S. Biological Survey as the leader.

Furthermore the whole question of extension is not so much a question of whose job it is in theory, as a question of who has the field personnel to do it in fact. Farm game is a land crop, and as such is naturally within the province of the Department of Agriculture The Department of Agriculture, through the interlocking machinery of the state agricultural colleges, already maintains a large field force in every state for the extension of ideas and technique to farmers. This force is increasingly active in extending forestry, rodent-control, and predator-control. Is there any escape from the fundamental logic of asking it to extend to farmers the ideas and techniques of game management?

A comparison between the numerical strengths of field man-power now maintained by various agencies is here in order. Wisconsin is probably a good sample, because it rates as an important state for farm, and also for forest, game, and fish resources. The field man-power of its governmental agencies classifies as follows:

Agriculture extension	150 men
Game and fish	65 men
Forestry	30 men
Total	245 men

Just how to gear up the field forces of agriculture, game, and forestry for game extension, I make no pretense of knowing. That such a process of gearing up is vital to the future of farm game, I assert without hesitation and without qualification.

The bearing of this discussion on the rôle of foresters is simply this: there is a proposal to divorce federal leadership in game and forestry from federal leadership in agriculture by transferring game and forestry to the Department of Interior. Foresters know that forestry and agriculture cannot be divorced, and this should enable them to see more clearly than other conservationists see it, the fallacy of divorcing agriculture and

game. If they see this fallacy, it is their duty to advertise it.

Training Needed

There is need of professional training in game administration. Present schooling facilities for game men are lopsided. Several forest schools offer graduate work in game research, but no institution as yet offers professional training in game administration. (I use these terms as follows: Game research is finding out things to do to the land to make it produce game; game management is the art of doing these things; game administration is the public function of fostering and supervising the practice of game management.)

Reversal of the fallacious conception of state game administration described in the preceding captions will come about not so much by writing new ideas, as by training new minds.

The difference between training in game administration and that in game research will parallel the differences already ably pointed out in forestry by Bailey and Spoehr.[3] The courses will be shorter, and give emphasis to game lands, game economics, and game finance.

The self-made personnel now administering game in nearly every state is analogous to that administering public forests two decades ago. The latter either acquired technical proficiency, or were replaced by technically trained men. The same process must occur in game administration.

The form of state conservation departments seems to be evolving toward combining game, fish, forestry, and park activities under a single director of conservation. This would indicate that combined training in forest administration and game administration would be especially advantageous.

Vocational training in game management is also needed, but this is less clearly a possible function of the forest schools. The agricultural colleges, with their proved success in short courses on agricultural subjects, seem better adapted to fill this need.

Sequence of Research and Management

There seems to be a current tendency to assume that management is something to be fabricated out of the findings of research, and therefore something to be deferred pending the accumulation of a large quantity of such findings.

I formerly entertained this assumption myself. It is logical and convincing—in the abstract. On more thorough reflection, however, I doubt its practical validity. Forestry, with an equally logical reason for research to precede silviculture, actually followed the reverse order. Silviculture was practiced in Europe long before research entered the recognized category of forestry activities.

Romell expresses my viewpoint very clearly in his recent paper on the somewhat analogous field of forest soils: "The motive underlying . . . the present . . . interest in forest soil research may be a hope to arrive at some clever short-cut to the most profitable silviculture, without the necessity of putting in scores of years collecting empirical data

[3]Bailey, I. W., and Spoehr, H. A., 1929. "The Rôle of Research in the Development of Forestry in North America."

from actual silvicultural operations. It might seem from a hasty look into European literature that this hope is warranted. I think that such a view is essentially wrong. Nowhere . . . is European silviculture built upon research; rather has successful research always built upon accumulated practical experience. The keen and interested foresters in the silviculturally prominent countries are the men who really have laid the foundations. The help which research has yielded to foresters has mainly been to explain and correlate facts which would otherwise have been isolated or not understood, to direct the ideas and formulate useful working hypotheses. Will it be possible, in this country, to reverse the order and create a good American silviculture with very little silvicultural experience? Frankly, I doubt it."[4]

I hope it is unnecessary to explain that this assertion in no wise lessens the urgency of, or necessity for, game research. It simply means that research is the lantern for guiding practice, rather than the material of which practice is originally compounded.

It also means that we must have practice before we can intelligently decide what questions research should try to answer. My brief experience in game research has taught me this: the field to be covered for each of our dozens of species is so enormous that it would require at least a generation to accumulate findings enough to suffice as the sole materials for a system of practice. Even if we had such an accumulation now, I doubt if we should know how to use them. A tremendous mass of silvical findings, with no previous silvicultural experience, would be in like case. We would not know how to use them. This conclusion is further corroborated by the historical fact that research zoölogists have seldom synthesized, from their vast accumulation of zoölogical knowledge, any concrete technique for use in game management, except in those rare cases where research and application went hand-in-hand. In those cases a very large and important synthesis of technique immediately resulted. Stoddard's forthcoming report, *Georgia Quail Investigation* is a case in point

I conclude we are getting nowhere with game management until we begin to practice it. Without it schools, fellowships, and research bureaus may contribute much to science, but little to conservation. The moral is that every game school should have a *piece of land* on which its research findings are tried out, and from which the subject matter of its research projects is drawn.

Game Literature

There are certain very specific contributions to game literature which foresters, jointly or individually, can make. To define these, it is first necessary to outline what literature is needed and what is available.

By analogy with forestry, we may set down the present need for game literature as follows:

1. A professional periodical on American game management, equivalent to the Journal of Forestry. Purpose: current dissemination of new knowledge and experience.

2. A text, "Principles of Game Management," setting forth the biological

[4]Romell, L. G., "Forest Soil Research in Relation to Forestry." *Jour. of Forestry*, October, 1930.

mechanism of game crops, and samples of the technique available for producing them. This would combine the equivalents of elementary silviculture and mensuration in forestry. Purpose: to serve as a foundational text book.

3. A text on "Game Administration" setting forth the accumulated experience of administrative agencies in fostering and supervising the practice of game management.

4. Monographs on the management of particular species or groups of species, or the practice of management on particular types of land.

5. A treatise on "Game Farming," setting forth methods of artificial propagation. This would be the equivalent of works on forest nursery practice and planting.

Of these five present needs, three are partially met.

American Game is a semi-popular periodical dealing to a large extent in game management and administration. It is the only American periodical which has made a systematic attempt to present papers on any other phase of management than artificial propagation.

Stoddard's *Georgia Quail Investigation* is an admirable species monograph, and the only single item in American game literature which may, without reservation, be described as dealing in the management, as distinguished from the zoölogy, of wild game. We need a dozen like it.

A series of pamphlets by various writers, a periodical, "The Game Breeder," and Job's book, *Game Propagation,* answer the fifth need to a considerable degree.

Foresters can of course not be charged with the regrettable lack of texts (2) and (3). The present opportunity for them lies in the need of a journal, and the need of studies of particular species of game.

While *American Game* has done pioneer work in interpreting management to the layman, it hardly fills the need for a technical journal. It is roughly equivalent to *American Forests and Forest Life,* an indispensable cog in the machinery of the forestry movement, but no substitute for the JOURNAL OF FORESTRY. Where, then, is a journal of game management to come from?

If game management were ornithology or mammalogy, the answer would be simple. But it is neither of these. It is a specialized branch of applied ecology, and deals with forestry, agronomy, animal husbandry, and all other land-cropping activities, quite as much as with birds and mammals. Moreover its practice will have an important effect on watershed conservation.

The answer seems to be that the JOURNAL OF FORESTRY, the *Journal of Mammalogy,* and one or more of the ornithological periodicals should become vehicles for the dissemination of current accretions to our thought and experience in game.

The JOURNAL OF FORESTRY has carried occasional papers touching on management, but most of them (including my own) have dealt with the appraisal of things thought by people, rather than with the measurement of things done to land. This preoccupation with human attitude is no longer necessary. Many foresters, especially in the federal service, are in the enviable position of actually doing things to definite units

of game land. If they will only measure the results on the game, and report them in the JOURNAL, they will be rendering a service comparable to that rendered by those early foresters who first brought the caliper, the yield table, the sample plot, and the marking axe into the tide of talk about timber famine. We have a game famine, but salty tears will not relieve it. Only two things will: reducing the population, or increasing the increment. Since we do not stomach the first, somebody must start finding out how to practice the second.

Primitive or wilderness areas are something new in the policy of the U. S. Forest Service. A primitive area, in the language of the foresters, is a tract of federally-owned land set aside to be kept in as near its natural and primitive condition as is physically and economically possible, in the interests of public education, research, and public recreation. Furthermore, no roads will ever be built into such areas, and only such trails as are necessary for their protection, nor shall any structures ever be built therein other than rude shelters of native or local materials needed for human protection from storms or the elements.

North Pacific Regional Office,
U. S. Forest Service.

SELECTIVE GIRDLING OF HARDWOODS TO RELEASE YOUNG GROWTH OF CONIFERS

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Girdling gives great promise as a method of reclaiming natural spruce and fir sites from the dominance of the overstory of hardwood left in early logging operations. The authors discuss girdling as practised by several organizations, and give the results of their experiments, as well as data on the growth of spruce and balsam fir following the girdling of the competing hardwoods.

WITHIN the last decade, producers of pulpwood in the northeastern United States and Canada have been turning their attention to the reclamation of natural spruce and fir sites which have been cut over several times for their softwoods and on which hardwoods now have the advantage. This is especially true of producers who are operating on a basis of permanent production.

As these hardwoods have practically no market value at present they have become "weeds" and not only take up space which the more valuable softwoods should occupy, but also suppress any softwoods which might form an understory.

To eliminate these unwanted hardwoods by felling them would involve too great an expense, especially where no use can be made of the trees. Felling hardwoods often damages softwood reproduction. A sudden removal of the overstory might also prove deleterious to the young softwoods by exposing them directly and suddenly to changed conditions. Girdling is a method which seems to offer a practical solution to the problem of releasing softwoods from suppression by hardwoods.

Girdled trees require from two to five years to die[1] and several years more before they cease to have value as a windbreak. During this time the taller softwoods become more windfirm and the smaller growth has a better chance to survive. Root competition and shade are gradually decreased and more light, moisture and warmth reach the forest floor. Litter and humus decompose more readily and furnish an extra supply of available nutrients, of which the young softwoods quickly take advantage. Thus the proportion of softwoods in a forest stand may be increased and mixed stands (transition type of spruce and hardwoods), especially on the lower slopes, may be changed to nearly pure softwood stands.

Several experimental types of girdling have been used in the United States and Canada, and, while all of them are effective, most of them are too expensive

[1]Girdled hardwoods do not often become windfalls, but disintegrate by degrees.

to be practical. Such methods include: 1. Peeling off the bark during the peeling season, after completely severing the bark with an axe into two rings of cuts around the tree, one above the other, from 6 to 12 inches apart. 2. Making a continuous V-shaped notch around the tree, about a half-inch into the sapwood. 3. Making two complete rings, one above the other, about 2 or 3 inches apart, around the tree with the axe. The top ring is made last and at each stroke the axe is twisted downward causing the chip to fly out. 4. Using a girdling saw. The Canada Paper and Power Company (8) find that girdling with the special saw is much cheaper and effective than that done with the axe. 5. The single ring chop—done during the winter. This method, adopted after much experimentation in the Adirondacks by Mr. H. L. Churchill, Forester for Finch, Pruyn and Company, consists in making only one complete ring around the tree, twisting the axe blade downward at each stroke. The girdling is done in winter and, as the wood is brittle at this time, it readily chips off. Advantages of winter girdling, aside from simplicity and rapidity, are: 1. It is much easier to work in the woods when most of the foliage is gone; 2. when snow is present the girdling can be done higher up on the tree, with a corresponding saving in time and expense.

The selection of areas to be girdled should be made carefully so that there will be no girdling which will not return interest on the investment. The number of hardwoods girdled on any area should not be so great that hardwood reproduction is stimulated to the detriment of softwood reproduction.

Finch, Pruyn and Company of Glens Falls, New York, girdle the hardwoods on only those areas which are sufficiently well stocked with softwoods. Exceptionally good hardwoods are exempted from girdling, especially if they occur where they are easily accessible to logging. These areas include spruce flats and lower mixed slopes in the Adirondacks (1). The number of trees girdled per acre varies from 25 to 135. With less than 25 hardwoods per acre the shade usually does little damage while, with more than 135, girdling is too costly, since there are too few softwoods present. The cost of this girdling has averaged about 3 cents per tree, including all time lost from work. The average diameter of the girdled hardwoods is 11 inches. The average time worked per day was 8 hours, and working 21 days per month.

Since there is but little available data on the results of the few girdling experiments now being conducted in northeastern United States and Canada, the writers have attempted to collect as much of it as possible and to augment it with figures obtained during the summers of 1928 and 1929 on Finch, Pruyn and Company's land in the Adirondack mountain region of New York. Growth measurements of released young softwoods were made on seven separate areas, comprising measurements on more than 1100 representative trees. Some additional data on girdling, in New England and Canada, was also obtained.

Historical

Only a few articles have been published in the United States on the gird-

ling of hardwoods as a means of releasing softwoods reproduction. References to three of them are as follows: In Maine, by Cary (2); in New Hampshire, by Westveld (3); in the Adirondacks, by Churchill (4, 5).

Girdling work which has not been reported in published form has been carried on for some years by several organizations. The Brown Company of Berlin, New Hampshire, has been experimenting for about five years and is still collecting data on girdling, both as to its silvicultural and physiological aspects.

The New England Box Company (6) girdled more than one hundred acres of mixed hardwoods and white pine in 1923, at Croydon Flats, New Hampshire. In order to improve the white pine, all hardwoods, except a few of the most valuable ones, were girdled. The white pine was cut in 1928 and stump measurements made by the writers in 1929 are given in Table 9 to show the effect of girdling in releasing the white pine.

At the Lake Edward Experiment Station in Quebec, three representative plots were laid out in 1922 (7). On one plot all hardwoods were girdled; on another 40 per cent of the hardwoods were girdled; the remaining plot was left ungirdled as a check plot. Increment borings in 1928 showed increases in the size of the annual rings of spruce and balsam proportional to the extent of girdling, as indicated in Table 1.

It can be seen that the growth was in a direct ratio to the amount of release, with the exception of the 6-inch class of balsam fir and the 8-inch class of spruce on the 40 per cent girdled plots. These discrepancies, if they can be considered as such, are doubtless due to the fact that there were not enough trees of these particular classes to give a fair average.

In the Province of New Brunswick (7) plots were laid out in 1922 and 1925. The girdled plots contained 50 acres each and the control, or ungirdled plots, 10 acres each. The trees, which were girdled, were unmerchantable hardwoods. The cost, using student labor, was approximately $1.25 per acre. No growth data are yet available on this experiment.

The Laurentide Division of the Canada Paper and Power Company, Grand Mere, Province of Quebec has experimented with girdling since 1917 (7). One of the aims in this work is to kill hardwoods under which softwoods have

TABLE 1

DIAMETER INCREMENT AS INFLUENCED BY GIRDLING

	Diameter class—inches				
	2	4	6	8	10
Spruce	Diameter increment—inches				
Plot ungirdled	0.10	0.57	0.31	0.83	___
Plot 40 per cent girdled	0.39	0.87	0.97	0.72	___
Plot 100 per cent girdled	0.59	1.09	1.54	1.04	___
Balsam fir					
Plot ungirdled	0.44	0.73	1.50	1.65	1.00
Plot 40 per cent girdled	0.67	1.50	1.16	1.71	1.40
Plot 100 per cent girdled	0.97	1.72	2.24	2.13	1.86

been planted; another, is to release natural softwood reproduction. Although no figures are available, this Company considers that the results, obtained thus far, are satisfactory, except in a few places where too many hardwoods were girdled.

Present Work

Measurements showing the "releasing effect" of girdling were taken by the writers on typical softwood areas in the Adirondacks, selected by H. L. Churchill on Finch, Pruyn and Company land. The areas were chiefly spruce flats with some transitional spruce flat—northern hardwoods land, and a small amount of spruce swamp.

Most of the measurements taken of softwood reproduction were of the growth of the leading shoots, since they showed striking increases in length the first season after the girdling was done. In nearly all cases measurements were made of the growth of several seasons, both before and after the girdling. Radial increment was studied on two different sections and the results are expressed in terms of basal areas.

Tables 2-8 inclusive, show the average "leader growth" of spruce and balsam in inches. Measurements are given for reproduction which has been entirely released by gridling; for reproduction which has been only partially released, but which will be free in a few years; and for reproduction which has not yet been affected by girdling. Some of the latter reproduction probably will never be released, or, at least, not for a number of years, since it occurs under young hardwoods which were not girdled and

Table 2

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

CEDAR RIVER 1926 AREA — GIRDLED IN SPRING, 1926

	Spruce					
Seasons	1924	1925	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.
Freed	5.7	7.0	9.0	9.9	12.6	13.6
Partially suppressed	5.1	6.2	9.2	9.6	12.6	12.0
Suppressed	3.0	5.0	6.5	6.5	9.5	7.0
	Balsam					
Freed	7.0	10.6	15.4	15.2	20.4	25.5
Partially Suppressed	4.9	6.5	9.3	8.9	12.5	14.8
Suppressed	2.8	3.0	6.0	7.0	9.0	15.0

Table 3

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

CEDAR RIVER 1925 AREA — GIRDLED IN SPRING, 1925

Seasons	1923	1924	1925	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.	In.
Freed trees	—	—	—	—	—	—	—
Spruce	4.7	4.3	6.1	9.3	10.4	13.4	14.1
Balsam	5.1	5.4	8.6	12.0	12.9	15.9	17.1

under overstories of other softwoods.

Figure 1 gives composite curves for spruce and balsam fir showing the relative rates of height growth, computed from the average growth figures for all of the areas studied, in which practically all variation due to seasonal differences and to variation in density of crown covers is eliminated. It is seen that growth after girdling has constantly increased while before girdling it was practically at a standstill. Although the girdled hardwoods die only partially the first year, spruce and balsam fir respond to the resulting small increase in light. As the hardwoods continue to die the response continues, and will last, apparently, until an equilbrium is reached which is comparable to the growth which unsuppressed trees of the same age and species make on the same site. This is indicated by the general trend of the curves and by the appearance of the reproduction itself on the areas studied.

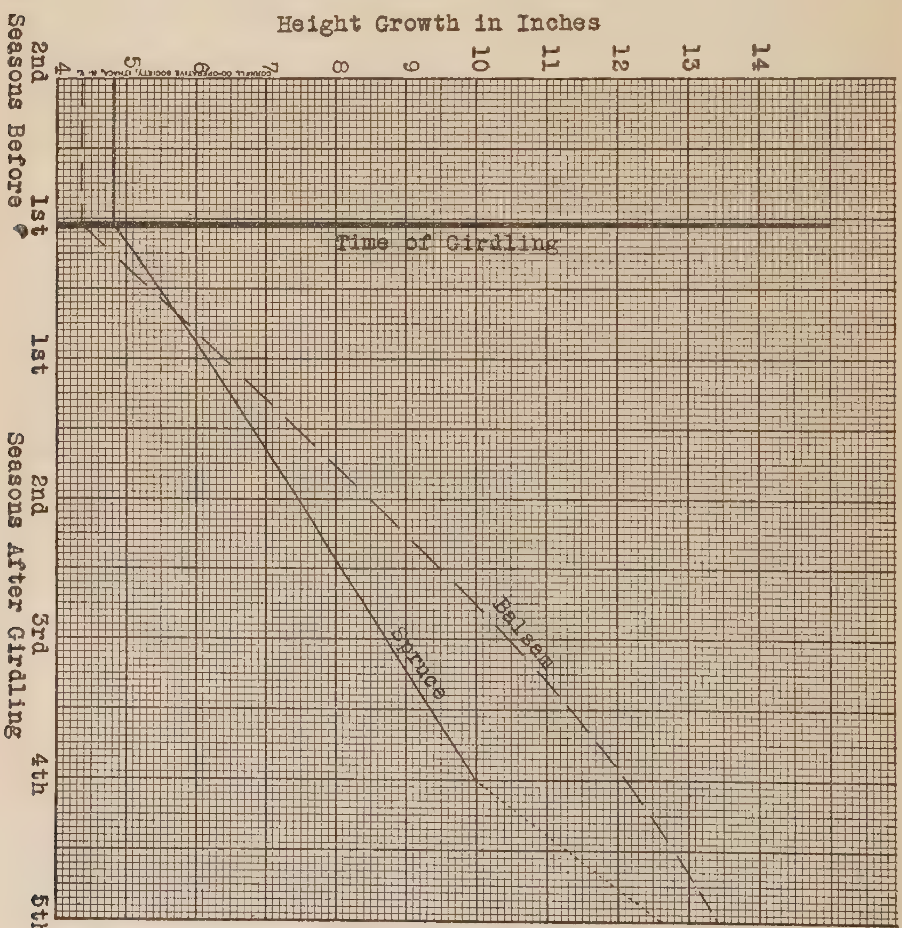

FIG. 1.—Relative rate of height growth of spruce and balsam fir after girdling of competing hardwoods.

The curve for spruce is continued as a dotted line to the fifth growing season after girdling because of inadequate data, due to the small number of spruce trees which have been freed for five years.

The growth of spruce previous to girdling was greater than that of balsam fir, since the spruce was older and of greater height, thereby having a more dominant position for infiltering light. The rate of growth of balsam after girdling is much greater than that of spruce. If this response on the part of balsam is sustained (the curves seem to indicate that it will not be) a special problem in management arises, since spruce is the more desirable species. It is believed that if a shorter rotation is used for balsam than for spruce, approximately forty and sixty years, respectively, the growth of spruce will be favored.

Studies made on one hundred trees each of spruce and balsam fir showed that the basal area of every diameter class is increased by girdling. After five years spruce, released by girdling, increased in basal area over the unreleased spruce by 25.1 per cent. Released balsam increased over unreleased balsam by 99.6 per cent. The released balsam was increasing in basal area approximately three times as rapidly as the released spruce.

The increase in rate of radial growth is not at once manifested strongly, as compared to height growth (especially in spruce), but after an apparent lag radial growth increases markedly.

In Table 9 is shown the releasing effect on white pine, 12-14 inches d.b.h., after competing hardwoods were girdled. Previous to girdling, the radial growth was decreasing year by year, while immediately afterward it increased until, at the end of six years, it nearly equaled the growth of trees in a dominant position throughout life. It is seen that girdling is effective in securing increased increment for trees of this age class as well as for young growth in the reproduction stage.

Physiological Aspects of Girdling

It is quite noticeable on all of the areas investigated that different tree species do not react alike to girdling and that they die at distinctly different periods after the operation. The observed order in which the girdled species die, all trees being girdled at the same time, is as follows: (1) white birch, (2) yellow birch, (3) red maple, (4)

TABLE 4

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

SIX MILE BROOK — GIRDLED IN FALL, 1926

	Spruce			Balsam fir		
Seasons	1927	1928	1929	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.
Girdled area	—	—	—	—	—	—
Freed	9.2	11.4	12.2	10.5	14.4	16.5
Partially suppressed	8.3	9.3	8.7	8.5	9.2	9.0
Suppressed	5.6	5.8	5.1	5.6	6.0	5.1
Ungirdled area	3.9	4.3	3.1	4.3	4.3	2.9

TABLE 5

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

TOWNSHIP 19 GIRDLED IN SPRING, 1926

	Spruce					Balsam fir				
Seasons	1925	1926	1927	1928	1929	1925	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Freed	3.2	4.3	4.5	5.0	9.7	4.2	5.1	5.9	9.3	14.3
Partially suppressed	2.5	3.1	4.2	6.2	9.0	2.6	4.4	5.3	7.5	9.7
Suppressed	2.6	3.3	3.6	5.6	8.6	—	—	—	—	—

TABLE 6

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

TOWNSHIP 16 GIRDLED IN WINTER, 1927-28

	Spruce				Balsam fir			
Seasons	1926	1927	1928	1929	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.	In.	In.
Freed	6.0	7.0	9.5	10.5	6.7	6.1	10.1	12.0
Partially suppressed	—	—	—	—	6.0	4.6	8.1	10.7
Suppressed	3.5	2.0	6.5	5.5	2.7	2.1	4.3	5.0

TABLE 7

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

GOODENOW FLAT GIRDLED IN SPRING, 1927

	Spruce						
Seasons	1923	1924	1925	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.	In.
Freed	3.4	3.0	3.2	3.2	6.4	8.4	10.6
Partially suppressed	2.0	2.3	2.3	2.7	3.7	7.0	9.0
Suppressed	2.5	2.5	2.5	1.0	2.5	4.5	5.2
	Balsam fir						
Freed	2.8	2.9	3.1	4.1	5.2	8.5	12.8
Partially suppressed	2.0	2.0	2.0	2.9	3.5	6.9	9.0
Suppressed	—	—	—	—	—	—	—

TABLE 8

HEIGHT GROWTH IN INCHES OF SOFTWOOD REPRODUCTION

CAMP SPRING GIRDLED IN SPRING, 1928

	Spruce				Balsam fir			
Seasons	1926	1927	1928	1929	1926	1927	1928	1929
Growth	In.	In.	In.	In.	In.	In.	In.	In.
Girdled area	3.1	2.8	6.5	7.4	2.4	2.5	6.4	8.1
Ungirdled area	1.3	0.9	1.1	1.5	1.3	1.4	1.6	1.6

hard maple, (5) beech, practically in the order of tolerance. The reason for the tree species dying in this particular order is not celar but is probably closely related to inherent differences in the functions of obtaining and using water and nutrients. Girdled trees die mainly because foods synthesized in the upper part of the tree cannot get to the roots and as a result the latter become starved. Also, much of the water and nutrients taken in by the roots cannot get to the limbs and leaves and thus metabolism is greatly retarded.

It may be that one species of tree can live longer than another one because it has a greater water and food storage system in its roots. Also it may have a greater "water efficiency." Differences in anatomical structure may be influential in prolonging life. For instance, beech trees which live from four to six or more years after girdling, contain much more xylem parenchyma than the other species, especially yellow birches, which die in one to three years. The parenchymatous substance contains a large amount of living tissue which contains much more mineral matter than the dead cells which form most of the xylem. This mineral matter is apparently transferable and can be conducted to where it is needed in the leaves, branches, and other parts. Thus the trunk of a beech tree is a storehouse for much nutrient material which is utilized after the tree is girdled, enabling it to live longer.

In many instances it was noticed that girdled beeches had sent up sprouts from their roots and some had formed sprouts on their trunks below the girdle. These sprouts were leaved out well and were capable of synthesizing food which could be used by the roots. The life of the roots would be prolonged, and thus also, that of the trees. The sprouts observed on one tree, just beneath the girdle, contained several fully formed and healthy beech nuts.

All species tend to live much longer when not properly or completely girdled. Many such trees were observed in an apparently good condition, five years after being girdled. These trees are sustained by a "callous" or strip of growing tissue. In several instances the callous was not much thicker than a lead pencil, thus evidencing the remarkable effort which trees make to live. In order for girdling to be effective the ring should be continuous and extend at least a half inch into the sapwood.

A number of the trees which have been girdled for more than a year were observed to be infected by fungous growths, mainly of the Fomes, Polyporus, and black shoestring types, which,

TABLE 9

RELEASE OF WHITE PINE BY GIRDLING
RADIAL GROWTH FROM STUMPS

	Radial growth in tenths of inches		
	1910-16	1916-22	1922-28
Trees in dominant position throughout lives	1.01	.89	.88
Trees in location to be affected by girdling	.43	.36	.83
Trees not in location to be affected by girdling	.42	.25	.17

in this case, are saprophytic wood destroyers and work mainly in the sapwood. Apparently these fungous growths do not hasten the death of the girdled trees to any great extent and so may be regarded as unimportant in connection with girdling.

Summary

The significance of girdling hardwoods to release softwoods and the several types of girdling in use today are discussed.

A short history of girdling in the United States and Canada is given with as much data on the results as are available.

Growth measurements of released young softwoods in the Adirondacks were made on seven separate areas, comprising a total of more than 5,000 acres of girdled land. The data showing the results of these measurements are given in Tables 2-9 inclusive.

A short discussion of the physiology and pathology of girdling is presented.

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SKELETON PLANTING

By EARLE STAFFORD[1]

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Close spacing in pure plantations of conifers is harmful to the soil as well as wasteful of stock and labor. Wider spacing and the planting of only the crop trees permits hardwood coppice and brush to fill intervening spaces and to act as soil improvers, but it requires more intensive management. Its benefits are more pronounced on the poorer sites.

SKELETON planting, or *the planting of the ultimate stand,* is a method of planting that is being tried out in an experimental way on Swann Forest in southwestern Massachusetts.

The method is still in the theoretical stage, although based, of course, on considerable field experience. It is extremely simple and direct, being nothing more than this: *the planting of only those trees that are intended to form the mature stand.*

The Types of Land Planted

The better sites.—The land commonly planted in Massachusetts consists largely of abandoned meadows and pastures. Such areas, at the time they are abandoned, are usually more or less "run out" due to prolonged over-cropping. The soil is apt to be somewhat sour, the organic content is low and the available plant food scanty.

From the moment cropping ceases on such land, however, improvement begins. If left alone, the land will pass through a series of vegetative changes, or successions, that will gradually restore it to productivity.

On the better sites—such as are found in bottom lands and on lower slopes—the plant successions that occur are commonly these:

1. The grass succession.
2. The herbaceous, or goldenrod-fern, succession.
3. The low brush, or bramble-hardhack-blueberry succession.
4. The high brush succession, characterized by such shrubs as alder, willow, hawthorn and cherry.
5. The sapling succession, consisting of volunteer maple, ash, oak, birch, poplar, pine, hemlock, and others, depending on the site and the neighboring seed trees.

These plant successions do not, of course, follow each other in any clear-cut sequence. They vary as to composition and in duration, and some may be omitted. They overlap enormously, so that all may be present in some degree in one plot at one time. For example, grass often persists into the sapling

[1]The author gratefully acknowledges the help and encouragement given these studies by Commissioner of Conservation, Wm. A. L. Bazeley and Chief Forester H. O. Cook.

stage, and some of the trees of this later stage may be discerned as small seedlings in the grass and herbaceous successions.

The climax in which this vegetative cycle will culminate in the course of, say, seventy-five to one hundred years, is, we may presume, a good quality mixed hardwood-conifer overgrowth of uneven age, with an undergrowth consisting of hazel, dogwood, viburnum, dwarf maples and a loose ground cover of the smaller shrubs and herbs common to rich woods.

It has, in fact, returned to the "primeval" forest type, somewhat altered, to be sure, by man's period of interference. Chestnut, for example, may be lacking. Tree growth is slightly reduced on account of early soil poverty. White pine shows the effect of the vast increase in weevil. And so on.

Such is the cycle, so far as we can trace it, on the *better* sites.

The poorer sites.—On the poorer sites —the leached uplands and dry, sandy flats—where the soil reaction is usually strongly acid, soil recovery and the plant successions take place much more slowly. Acidophile plants are usually in the ascendency, and the low brush, or hardhack-blueberry, succession is apt to be exceptionally pronounced and prolonged.

These lands, as a rule, do not promise much in the way of productivity. They have lost a great deal of lime that can never, by any natural process, be recovered. To be sure, they often contain large stores of *potential* plant food, but these stores are released for use very slowly. Only plants able to adapt themselves to a highly acid medium and able to exist on relatively little food and water will commonly survive on them. Many conifers and certain hardwoods (some oaks, for example) are able to adapt themselves to such conditions, but they naturally do not make the growth here that they would in better soils.

If, as is often the case, exposure to high winds is added to the other adverse conditions found in these places, the development of forest growth is slow indeed. Plantations on such land make very slow progress.

Certain dry, sterile fields tend to remain indefinitely in the grass and herbaceous stages, and show no discernible soil improvement after a decade or more. In default of some artificial improving of the soil, it would seem a matter of wisdom to defer the planting of such land until there is clear evidence of some returning fertility, as disclosed by the quickening of the growth on it.

Conifers will make a show of growing on almost any soil, so great is their persistence and economy. But soil exhaustion not only checks the physical growth of the tree but lowers its resistence against insect and fungus attack. It undermines, at the beginning, that inner vitality that is the foundation of long life.

Recently cut-over land. — Another type of land that is occasionally planted is that which has been recently clear-cut. If, as is usually the case, the stand removed was coniferous, the soil is apt to be in a somewhat inactive and acid condition—the "podsol" soil of Hesselman. A considerable amount of organic matter ("raw humus") has accumulated in this soil however, and the altered conditions brought about by the removal

of the stand—the greater amount of air and sunlight, attended by the increase in broadleaved growth—soon unlock these reserves and bring a return of soil productivity.

Plant successions occur on cut-over land much as they do on old fields, except that the grass succession is omitted, and the herbaceous and low brush successions are usually brief. The area is likely to break out almost immediately in seedling and coppice brush of the forest type, and volunteer hardwoods, that had developed under the mature conifer stand, are ready to take over the ground.

It is evident that the planting of such land is usually unnecessary. Planting would result in the wholesale suppression of the transplants, or in the necessity for wholesale releasing, the cost of which is out of proportion to the value of the trees released.

Plant Successions Important Aids to Improve Fertility

How is the improvement that takes place on abandoned fields to be accounted for? That such improvement does occur is abundantly manifest in the gradually increasing luxuriance of the plant growth itself in such lands.

Conifers set out during the grass or herbaceous successions are often seen to do poorly for a number of years (5 to 10 or more), and to exhibit an unthrifty foliage of a yellowish cast—strong evidence that there is a lack of available nitrogen in the soil. A gradual change takes place, however. As the years go by many of the trees develop a thriftier foliage of a sparkling blue-green color. The supply of available nitrogen is plainly increasing.

The plant successions are largely responsible for this important change. They help subdue soil acidity by reaching into the lower soil strata for new supplies of lime and other bases to deposit, as they die and decay, in the acid surface layer. While permitting abundant air and the warmth of the sun to reach the soil, they throw over it a protecting mantle of moisture and shade. In dying down, they give to the soil an ever-increasing fund of organic material—always the foundation of soil fertility. In a word, they re-create little by little the exact conditions that are most favorable for the growth of soil bacteria and the abundant nitrification that these cause.

If we are to accept all this as true—and it seems to be in accord not only with our visual experience in the field but with the published findings of recent investigators—then the following fact stands out clearly: *Any interruption of the normal plant successions by early closing over of a conifer stand* will arrest soil recovery beneath the stand, and tend to lead to a confirmed "podsol" soil as opposed to a "mull" soil condition and to an inferior or worthless stand[2] as opposed to a stand of assured quality, reared on the solid foundation of soil fertility.

Close and Wide Planting Contrasted

Such, then, is the type of land com-

[2]Such, for example, as many stands of "old field" white pine in New England, where the pines took possession of a "run-out" site before the normal plant cycle had time to return fertility to the soil.

monly planted in Massachusetts. We are now ready to consider a typical plantation of the past on such land—pure white pine, let us say, planted six feet apart, or at the rate of 1200 trees to the acre. This is the type of which we have some 80 acres on Swann Forest; and which represents, perhaps, the norm of the practice in the region in the last two decades.

Let us assume that 300 of these pines will occupy a fully stocked acre at the time of cutting (70 years). In order to obtain these 300 trees it will be noted there were planted 1200 trees or 900 more than there is ordinarily any intention of using. The reasons for this close planting and the benefits expected therefrom were substantially these:

1. To allow for expected losses from one cause and another.

2. To procure a long, straight branch-free stem on each tree, by crowding from the side.

3. To shade the ground as soon as possible in order to obstruct brush, "weed" trees and other undesirable growth.

The disadvantages of planting 1200 white pines (or other conifers[3]) where only 300 are to stand ultimately have of late become increasingly evident in the plantations themselves. In our experience these disadvantages are as follows:

1. It costs nearly four times as much to plant an acre to 1200 trees as it would to plant 300.

2. It places a greatly added burden on the soil resources, and often permanently injures the soil (since soil regeneration is halted before it is fairly begun by the premature closing over of the stand). The result is lessened tree growth.

3. It involves undue root competition, likewise resulting in lessened tree growth.

4. It involves the need of one to several thinnings.

5. It increases the field of operation of such pests as white pine weevil (the 900 extra trees constituting, in effect, merely so much *weevil-fodder*)[4].

6. It increases the cost of management operations in general, since there are many more trees to deal with, a majority of them *no part of the expected crop.*

Granting that the disadvantages as listed above are such in fact, then conversely the advantages to be expected from wide spacing (in this case 12x12) should be the following:

1. It is more economical and permits of more careful planting.

2. It is not exhausting or detrimental to the soil, allowing the vegetative cycle, and soil recovery, to progress undisturbed.

3. It involves no root competition for many years, thus insuring maximum growth and vigor to each tree. (The competition with hardwood brush is not considered serious, as the presence of a flourishing brush denotes active nitrification and the brush is only a *temporary compeititor,* that will ultimately be "plowed in" and become available for the nutrition of the stand.

[3]Many of these disadvantages apply equally well to hardwoods.

[4]If we wished to cultivate weevils on an extensive scale we could probably do no better than grow pure white pine from 4 to 6 feet apart on exhausted fields.

Furthermore, it is doubtful if hardwoods can ever "run out" conifers except by shading.)

4. It eliminates the need of thinning.

5. It diminishes the field of operation of such pests as white pine weevil.

6. It decreases the cost and increases the efficiency of management operations in general, since there are far fewer trees to manage, and these few *are the crop.*

Benefits of Close Planting Not Lost In Skeleton Planting

The benefits ascribed to close planting above are expected to be achieved in the new plan of wide spacing or "skeleton" planting as follows:

To replenish losses — As trees die, they may be replaced from the nursery, or a fast-growing species may be substituted to catch up. After the first year or two, deaths in a widely spaced plantation should be few. If losses result in an uneven-aged stand, no harm is done.

To obtain a long, straight, branch-free stem—This is really the vital point on which the success or failure of wide-spacing rests.

So far as a long straight stem is concerned, our observations seem to show that the need of early side-crowding of conifers is perhaps not so great as we believed. Their habit of growth is strongly upward, during the first two decades at least, whether they are crowded from the side or not.

As to early natural pruning, or early pruning of any kind, the question has lately been intelligently raised whether it is always as essential, or desirable, as once believed. At any rate, in a 6x6 conifer plantation it is usually something like ten years before side-crowding begins, and fifteen years before it is really influential. In this time, on many of the better sites, brush would have developed extensively, and would have begun to exert, it is believed, a more pronounced and more beneficial influence than can be obtained from one conifer crowding another.

Our idea, therefore, is to *encourage brush to grow up around the trees and crowd them from the side.* On many sites a good growth of such species as alder, hazel, cherry, willow and sapling deciduous trees will enter and should reach a height of from 5 to 20 or more feet between the plantation rows, and thus provide abundant shading of the *best kind.* All this broad-leaved material will, in the course of time, die down to become a part of the soil. For this reason it is important that all hardwood brush cut in the process of releasing should be scattered to decay *within the plantation.*

If desirable volunteer hard or softwood trees spring up and if they are properly spaced, they may be permitted to become a part of the stand.

The management of such a plantation would involve more attention to keep the trees released than would a 6x6 plantation. *Brush control* will be an important feature, and no tree must be allowed to become over-topped by the brush. ("Brush" includes all sapling trees that are not wanted for the stand.) The amount of actual work to be done on a widely-spaced plantation is relatively slight, but supervision must be unremitting.

The practice of wide-spacing is re-

stricted at present to the *better sites*—those on which abundant hardwood brush can be counted on or in some manner induced, but it is the intention to try out the method on some of the poorer sites, since it is exactly on these sites that the disadvantages of close-planting are most pronounced, and that are, for that reason, in greatest need of the soil improvement expected from wide-spacing.

To keep down brush and other undesirable growth—As already shown, brush is not an undesirable, but a highly *desirable* furnishing of the plantation, not only during the important early years, but throughout the life of the stand. Herbs, brush, and "weed" trees—all are grist for the mill. All supply shade and atmospheric moisture; all build up humus-forming proteins and carbohydrates; all go into the hopper in the end.

Skeleton planting is, in reality, *intensive* forestry. Waste is eliminated. The individual tree becomes the important objective. From the seed-bed to the harvest the forester concentrates on its health, vigor and final utility. Like Andrew Carnegie, we put all our eggs in one basket and then watch the basket. We plant our final stand, and take care of it. We are, in fact, engaged in two operations simultaneously: growing the timber stand and building up the soil.

The purpose of skeleton planting (as of any planting) is to insure a well-spaced, fully stocked stand of good timber trees in desirable mixture. In this purpose we are willing to accept nature's help or correction at any stage. In fact, we believe that planting should be practised only with a view to *supplementing* natural reproduction. Some conifer plantations when left to themselves have been partly or wholly suppressed by thrifty hardwoods of the better kind growing up through them and overtopping them. This is likely to occur on many of the better soils in our section. To insist on maintaining the conifers in such a case would result in a "strong-arm" plantation. This is unsound because it runs counter to the natural trend.

No pure coniferous stand should cover, *unbroken*, more than about one-quarter acre. The soil under it should be everywhere within the influence of neighboring hardwoods. This has been demonstrated on the Harvard Forest by Professor Fisher who believes that hardwoods are an indispensable component of any stand, if soil fertility is to be maintained at a high level. Likewise we believe that a single species of hardwood in a pure stand ought not to occupy a greater area than, say, the quarter-acre allotted to conifers. Here, too, the dual influence of conifer and hardwood is most conducive to soil health and is in effect a crop rotation under a continuous crown cover.

The skeleton plantation, in theory at least, promises a wide-sweeping simplification of the whole planting problem. At one fell swoop we do away with the 900 extra trees, we cast off this pest-ridden, unwieldy burden forever, and deal only with the ultimate stand in all its simplicity, flexibility and finality.

We believe that there is so vital a grain of truth in the theory that, even if it does not work out as is hoped, it points the way to better methods.

Conclusions

1. Planting is advisable only as it seems necessary to supplement natural reproduction.

2. The best type of stand to aim for is a natural hardwood-softwood mixture of uneven age.

3. On the better sites the trial of wide spacing or skeleton planting as offering the solution of many plantation problems, is suggested.

4. On the poorer sites postponement of planting until the land shows definite improvement under the influence of the normal plant cycle is recommended.

CURRENT GROWTH IN NORWAY PINE[1]

By T. SCHANTZ-HANSEN

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The author presents data on the growth of Norway pine in virgin stands. Inasmuch as this species in the older age classes is rapidly disappearing, the data presented have permanent value for comparative purposes.

NORWAY pine (*Pinus resinosa*) is one of the most valuable of timber trees for the Lake States region. It was very abundant in the virgin stands and is becoming increasingly important in the second growth. On certain areas in this region Norway pine should be favored above all other species. Unfortunately, the remaining mature stands are being cut rapidly, thus decreasing the opportunities for collecting growth data. Contributions to our knowledge of the growth of Norway pine should, therefore, be of interest and of practical value in the management of the species.

Description of the Stand

The two-acre plot, on which these observations are based, is one of a series of thinning plots established in the early days of the existence of the Cloquet Forest Experiment Station. For some reason or other, the plot was never thinned and consequently it can be used only for studying the growth of the species which go to make up its stand and the development of the stand itself. The portion of the stand in which the plot is located is a mixture of Norway and jack pine. Very little underbrush is present. Reproduction has just begun to come in during the past five years. There is a good layer of humus covered by a heavy layer of duff, which does not decay rapidly. The ground cover consists principally of blueberry, sweet fern, honeysuckle and wintergreen. The soil is sand, grading off into a rather coarse gravel at two feet.

As is typical in this region, the stand has been subjected to a number of fires. Fire scars show five fires to have burned through the stand, the last one in 1894. This, no doubt, has influenced the yield considerably.

When the plot was established in 1913 the Norway pine averaged 88 years old and the jack pine 86 years old. This would make the Norway pine 103 years old and the jack pine 101 years old at the time of the fifteen-year remeasurement.

At the time of establishment there were 117 trees per acre on the plot. This is a relatively open stand even for this age class. Chapman and Woolsey (1) show 193 trees at 90 years. This is, of course, a theoretical number, arrived at

[1]Published with the approval of the Director as Paper 764 of the Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota.

by squaring the diameter of the average crown and computing the number of trees that could stand on an acre. It would not be fair to assume that this plot was understocked to the extent shown by these figures. The stand is not a pure Norway pine stand. At the time of its establishment there were 70 Norway pine, 45 jack pine and 2 white pine per acre. Even though it is mixed, the behavior of the Norway pine should be typical of many of the stands in this region.

The results of the ten-year measurements of this plot have been previously published (2). Because of their brevity, and for convenience sake, all figures are repeated herewith. A comparison between the volumes given in this article and the previous one show some discrepancies. This is due to a difference in the method of applying the volume tables. All volumes in this computation are made on the same basis.

Mortality

During the fifteen-year period there has been a loss of 23.5 trees per acre, *i. e.*, 20 per cent of the original stand. The bulk of the loss has been in jack pine, which is well past maturity in this stand. Only one Norway pine per acre was lost from natural causes and two per acre by necessary cutting. The Norway pine is evidently not yet decadent. The opening up of the stand through the loss of the overmature jack pine should prove helpful in stimulating or at least maintaining the rate of growth. Table 1 gives the proportion of the various species and the loss during the three five-year periods.

TABLE 1
MORTALITY BY SPECIES

	Norway pine		*Jack pine*		*White pine*		*Per cent loss*	
Year	Per cent	Number lost per acre	Per cent	Number lost per acre	Per cent	Number lost per acre	Total trees per acre	Based on previous stand
1912	59	—	39	—	2	0	117	—
1917	63	.5	37	12.5	2	0	104	11
1922	71	.5	27	6.5	2	0	97	6
1927	72	2.0	26	1.5	2	0	93.5	3

Diameter Growth

Table 2 gives the d.b.h. of the average tree for Norway and jack pine at the four periods.

TABLE 2
DIAMETER OF AVERAGE TREE

Species	1912	1917	1922	1927
Norway pine	13.9	14.8	15.2	15.5
Jack pine	12.1	13.1	13.3	13.3

The diameter of the average tree was computed from the average basal area.

The loss in numbers did not affect the average diameter, since in each instance the average diameter of the trees lost practically coincided with the average tree for the entire plot. There is a marked increase in diameter from 1912

to 1917, with a distinct slowing up from 1917 to 1922 and from 1922 to 1927. This is to be expected in jack pine, although the degree of change is rather large, but not in Norway pine where the current annual growth is usually not considered as culminating for another ten-year period.

Volume Growth

The volumes of the Norway and jack pine on the two-acre sample plot were computed, using the volume tables prepared by Woolsey and Chapman (1) and by Sterrett (3) for jack pine. These were the best available tables for use in 1922 and since the comparison between different periods is the important point they were used in 1927.

Table 3 gives the actual volume of the stand on an acre basis at the four periods measured.

Norway pine shows a steady increase in net volume while jack pine shows a decrease. The growth is not sufficient to offset the loss in numbers for jack pine, but it more than compensated for the loss in Norway pine. The largest increase in volume for Norway pine occurred between the years of 1912 and 1917.

The actual net increment per acre per year and its relationship in per cent to the volume of the stand at the beginning of the period is shown in Table 4.

During the last five-year period Norway pine lost 790 board feet or 193 cubic feet through necessary cutting, and nothing from natural causes, while jack pine lost 538 board feet or 146 cubic feet through windfall and death. While there is a falling off in the rate of growth in the Norway pine, the stand in undoubtedly not decadent. Jack pine, however, continues to give conclusive proof that it is past maturity, and rapidly disappearing from the stand.

The very marked decrease in volume growth after the first five-year period is striking. It might be due to several causes. When the plot was established the bark was smoothed off and the trees numbered with white paint. If the measurement were made after the numbering it would tend to give the trees a smaller diameter than was actually the case. The effect of the bark blazing would probably have largely disappeared by the time of the next measure-

TABLE 3

VOLUMES PER ACRE

		Norway pine			Jack pine		
Year	Age of stand	Basal area square feet	Board feet, Volume	Cubic feet, Volume	Basal area square feet	Board feet, Volume	Cubic feet, Volume
1913	88	74	10,800	2,690	38	4,350	1,180
1917	93	82	13,150	3,150	35	4,200	1,100
1922	98	85	13,650	3,240	26	3,500	900
1927	103	88	14,050	3,360	24	2,300	810

ment. The rate of growth might actually have occurred as indicated if the stand had passed the culmination of the periodic annual growth. A deficiency in rainfall might have caused the rapid dropping off in rate of growth.

In the previous article (2) the theory was advanced that the falling off in rate of growth was due to the deficiency in rainfall during the growing season. The data at that time seemed to support this theory. An analysis of the subsequent rainfall data, however, seems to indicate that this is not the case.

The first period from 1912 to 1917 received a total of 143 inches precipitation, or 29 inches annually. The second period received 134 inches precipitation or 27 inches annually, while the third received 131 inches precipitation or 26 inches annually. The difference in annual precipitation between the first and second periods might be sufficient to affect the growth rate, but the difference between the second and third period is so slight that it should have no bearing on the rate of growth.

The important point is of course the precipitation during the growing season. If we consider the average rainfall during the growing season from April 1 to August 31, we find that the first period has an average of 17 inches each growing season, the second 15 inches and the third 16 inches. The differences of 2 inches each year during the growing season between the first and second periods might account for a diminishing rate of growth. If so, an increase of 1.35 inches each year during the growing season should have stimulated the rate of growth from 1922 to 1927. This has not been the case.

In all probability Woolsey and Chapman (1) place culmination of the mean annual and periodic annual growth too far along in the life of the stand. For a Quality II site, such as this stand occupies, they place the culmination of the periodic annual growth at 120 years and the culmination of the mean annual growth at 140 years. Table 5 shows the periodic annual growth per acre and the mean annual growth for this stand.

From the data given in Table 5 the mean annual growth culminated at 93 years. If the same spread of years prevailed between the culmination of the periodic annual growth and mean annual growth as is shown in tables con-

TABLE 4
NET INCREMENT PER ACRE PER YEAR

	Norway pine				Jack pine			
Year	Board feet	Per cent of volume at beginning of period	Cubic feet	Per cent, Volume	Board feet loss	Per cent, Volume	Cubic feet loss	Per cent, Volume
1917	470	4.3	92	3.8	30	0.7	16	1.5
1922	100	0.7	18	0.6	140	3.4	40	3.6
1927	80	0.6	24	0.7	240	1.1	18	1.9

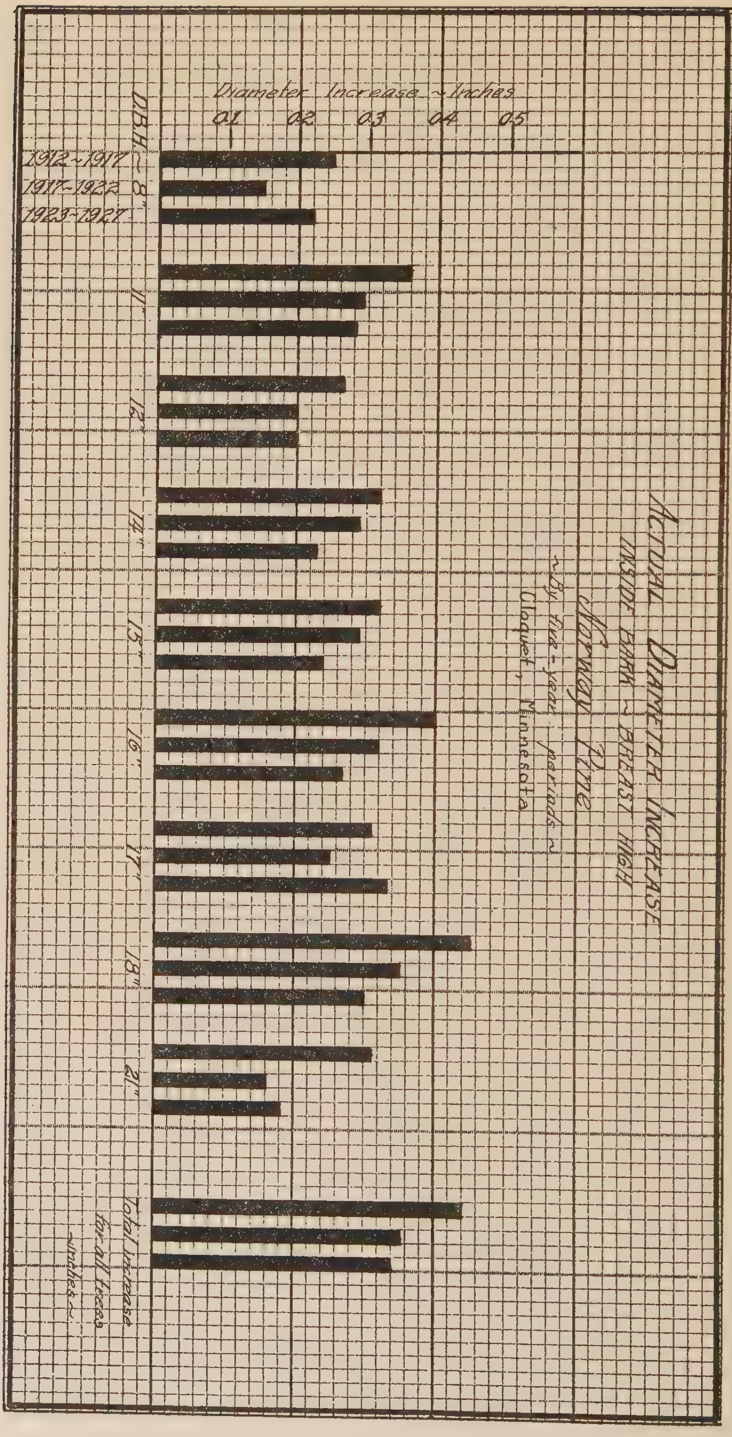

Fig. 1.—Diameter increase of each class.

TABLE 5

MEAN ANNUAL AND PERIODIC ANNUAL GROWTH PER ACRE

Age Years	Mean annual growth board feet	Periodic annual growth board feet
88	123	——
93	152	466
98	139	102
103	136	85

structed by Woolsey and Chapman, then the periodic annual growth would have culminated at 73 years in this stand. Apparently this stand matured at a much earlier age than those used as a basis for the yield table.

In order to check up on the possible error in measurements influencing the rapid drop in rate of growth increment borings were taken on twenty-four trees throughout the range of the diameter classes. The increase in diameter for each class is shown diagrammatically in Figure I. There was evidently a marked slowing up of rate of growth after the first period. As might be expected there would be some variation in the individual diameter classes. The 11-inch, 16-inch and 18-inch diameter classes which show the largest drop in rate of growth between the two periods comprise 15 per cent of the stand. From this evidence it would seem that the periodic measurements are not far wrong.

From the evidence provided by this study in current growth it seems probable that the present yield tables place the culmination of the periodic annual growth at too great an age. One plot is, of course, not sufficient evidence upon which to make any conclusive statements. In this stand periodic annual growth culminated at 70 to 80 years. Empirical observations based on stump analyses indicate that this is probably the normal age. Further studies in the growth of the species are necessary to determine the applicability of this conclusion to all stands.

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THE DEFECTS AND SOME OTHER CHARACTERISTICS OF VIRGIN-GROWTH AND OF SECOND-GROWTH COMMERCIAL SHORTLEAF PINE LUMBER

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The forester who strives for volume production and neglects a consideration of the probable grade and quality of the second-growth lumber product may find his efforts misdirected. Second-growth lumber from most species differs markedly from that of virgin growth and its utility varies as a consequence. The study reported in this article, although limited to one species, is timely and important in that it directs attention to the differences between the two classes of lumber.[2]

STUDY of the characteristics of the second-growth southern yellow pine now being cut in considerable volume is very timely. Ordinary precaution with respect to the future for second-growth lumber demands consideration of the potential values in the new forest crop, of uses that will be open for the type of lumber produced, and of the modifications in processes or in properties that will be necessary to meet the markets originally built up and still served by virgin timber.

Characteristics that are significant for comparative purposes are: Defects, rate of growth, heartwood content and of course strength properties, shrinkage, behavior in seasoning, and the like. A great deal of investigative work must be conducted before our knowledge of the properties of the second growth of any species will be comparable to that of virgin growth, but some light can be thrown on differences in heartwood content, width of annual rings, and characteristic defects of shortleaf pine from studies already under way. The characteristics of the defects and of rate of growth and other properties are ultimately dependent upon degree of stocking, age, site, and specific conditions of management. Although the information available at present can not be correlated with specific conditions of growth, yet it is based on a large amount of material and covers a wide range of growth conditions and therefore it undoubtedly represents the bulk of the lumber that really characterizes the species. The findings of this study are confirmed by data collected in other studies that do tie qualities in to definite stands. Never-

[1] Maintained at Madison, Wis., in coöperation with the University of Wisconsin.

[2] Studies of the kind here reported are needed for all species of major commercial importance, and they should be accompanied by investigations into the suitability of the second-growth material for each of the uses to which the virgin growth is now put. Such a companion study should indicate to what extent the second-growth product can maintain the market position of the original growth and should offer some data of fundamental importance in predicting future trends and needs for lumber. *Ed.*

theless, some exceptions will probably be found at times.

The term "shortleaf" as used in this article refers to the commercial mixture of both shortleaf and loblolly that is marketed as shortleaf, or Arkansas soft pine, or North Carolina pine, depending on the region where it is produced. "Virgin-growth" is used in the same sense as the one ordinarily employed by lumbermen; it refers to timber that has not been previously logged over, although the timber may vary in age, size, and maturity in accordance with the history of the stand. "Second-growth" refers to timber that has grown up to sawlog size either from seed on abandoned farms and cut-over areas or from small trees that survived an earlier logging.

The comparisons drawn are based on studies by the Forest Products Laboratory that have been made incidentally in a general investigation of the characteristic defects, texture, and heartwood content of the more important softwood species.

Five mills in Arkansas, Louisiana, Mississippi, Georgia, and South Carolina were picked with the advice of the lumber associations to represent commercial shortleaf lumber as it is now being manufactured. Of these mills the first three, where 24,000 feet (board measure) of lumber were studied, were large plants cutting practically nothing but virgin-growth shortleaf, and the other two, where 11,000 feet (board measure) of lumber were studied, were concentration plants machining lumber sawed by some twenty or more portable mills scattered about the localities and cutting exclusively second growth. There is good reason to feel confident that the lumber being cut at each mill was typical of the local conditions at that mill, although it was impracticable to check this finding except by general observation supplemented by the opinion of association and company officials.

At each mill a representative lot of dry boards 1 inch in thickness and 8 inches in width and of each commercial grade was given intensive study after the grade had been verified by competent graders. Each board was examined in detail and a complete record of all defects was made on especially prepared forms in accordance with the definitions and classifications of defects in American Lumber Standards. With knots, for instance, the number, size, tightness, color, and so forth were recorded. The degree and the estimated percentage of surface affected were also recorded for other defects, such as shake, decay, and stain.

Practical considerations made it necessary to limit the study to one width of lumber. The 8-inch width, as already noted, was chosen, because it is the width used as the basis for describing certain grades in American Lumber Standards, it is intermediate between the narrow 4-inch and 6-inch boards on the one hand and the wider 10-inch and 12-inch boards on the other, and it is the most readily available width at the average mill. Further, two excellent reasons exist for believing the 8-inch width to be representative. The maximum size of knots allowable in any grade varies with the width of the board, and 8 inches is the best average in this respect. Again, lumber manufacturing methods insure the production of a fair

proportion of 8-inch widths from logs of all sizes except the smallest.

Some General Distinctions

Grade Yields.—Probably the most pronounced difference between lumber from virgin-growth timber and that from second growth lies in grade yields. The figures of Table 1 are good approximations for shortleaf pine.

Table 1

GRADE YIELDS IN DIFFERENT TYPES OF SHORTLEAF PINE

Grades	Virgin growth	Second growth
	Per cent	*Per cent*
B and Better	15	3
No. 1 Common and C	26	19
No. 2 Common	44	60
No. 3 Common	15	18

Log-run lumber from virgin-growth timber consists more largely of the upper grades and, therefore, it is decidedly superior to log-run lumber cut from second-growth.

Heartwood Content.—In view of the significance of heartwood content on decay and stain resistance and on treating and impregnating qualities, a comparison between virgin growth and second growth on this basis is very important.

The heartwood content of boards cut from virgin shortleaf averaged about 50 per cent of the volume and from second-growth about 25 per cent. (Table 2.)

These figures apply to what may be thought of as average log-run boards. They were obtained by weighting the average heartwood content for each grade given in Table 1 according to the

Table 2

HEARTWOOD CONTENT OF LOG-RUN BOARDS OF SECOND-GROWTH AND OF VIRGIN-GROWTH COMMERCIAL SHORTLEAF

Heartwood content	Virgin growth	Second growth
Area of face of board in per cent	Percentage of log-run boards	
0 to 33	40.7	65.4
34 to 66	13.6	20.0
65 to 100	45.7	14.6

Average heartwood content:
Virgin growth 49.3 per cent
Second growth 26.5 per cent

percentage of the log run falling in the grade.

A low heartwood content, 0 to 33 per cent of the area, was found in 65 per cent of the second-growth boards and in only 40 per cent of the virgin growth, when the full run of the log was taken into consideration. On the other hand, a high heartwood content, 65 to 100 per cent, occurred in 46 per cent of the virgin-growth boards and in only 15 per cent of the second growth. Boards of half heart and half sap (34 to 66 per cent) occurred a little more frequently in the second growth.

Width of Annual Growth Ring.—Rate of growth or width of annual growth ring is frequently referred to as an important point of difference between virgin growth and second growth. Except for structural grades the rate of growth is not a factor in grading, but in the future when closer selection is practiced probably it will become more important. At present the lumber trade shows a decided preference for lumber of slow growth. Some extremely wide-ringed stock is being used in the manufacture of finish and appears to possess in large measure the qualities of softness and

workability that are desired for interior trim, although paint does show a tendency to flake off from the summerwood more easily in wide-ringed stock than in narrow-ringed. As to differences in seasoning qualities and shrinkage tendencies, little of a definite nature is yet known.

Less than one-quarter of the boards cut from virgin shortleaf in this study can be termed wide-ringed (1 to 4 rings per inch), whereas one-half of the second-growth stock fell in that class. (Table 3.) On the other hand a little more than 25 per cent of the pieces from virgin growth could be classed as narrow-ringed stock (9 or more rings per inch) and less than 10 per cent of the second growth could be so characterized. Approximately half of the virgin growth and nearly a half of the second growth fell in the class of medium rate of growth.

Table 3

WIDTH OF ANNUAL GROWTH RING IN LOG-RUN BOARDS OF SECOND-GROWTH AND OF VIRGIN-GROWTH COMMERCIAL SHORTLEAF

Ring class	Virgin growth	Second growth
Number per inch	Percentage of log-run boards	
1 to 4	20.2	50.0
5 to 8	52.5	41.3
9 and more	27.3	8.7

Knots—The Most Important Defect of All

Size and Number of Knots.—Knots comprised 70 per cent of all defects found in the commercial shortleaf pine studied. The southern yellow pines in general have fewer but larger knots than other commercial pines,[3] and among southern yellow pines second-growth shortleaf is the knottiest. Its knots averaged one-third larger than those in virgin shortleaf, and they were more numerous grade for grade. Columns 3 and 4 of Table 4 show this condition plainly, and Columns 5 to 10 offer an interesting comparison between virgin and second-growth shortleaf as regards the proportion of knots falling in the different size classes. Virgin timber had a much larger proportion of knots of the smaller sizes. In the quarter to half-inch class there was little difference. Knots from one-half inch to 3 inches in diameter were more important in second-growth and it was the preponderance in these sizes that made that type the more coarsely knotted of the two. In brief, then, knots covered about the same range in size in both virgin-growth and second-growth shortleaf but were more numerous in the second-growth and further a larger proportion of them approached the maximum sizes allowable in the different grades.

The lumber from second-growth shortleaf was cut from smaller logs. If both lots of lumber had been sawed from logs of equal diameters the difference in size of knots would probably have been greater.

No doubt differences in growth conditions help to explain the differences in knot characteristics. How far it is possible or practical to control the size and the number of knots by controlling the density of the stand is an interesting question that remains unsolved.

[3]This statement applies to yard lumber only, shop grades not being included

TABLE 4

NUMBER AND SIZE OF KNOTS IN A RUN OF LUMBER FROM VIRGIN-GROWTH AND SECOND-GROWTH COMMERCIAL SHORTLEAF PINE

Type of growth	Grade	Average number of knots per 8 feet, board measure	Average size of knots	Size classes—inches					
				0-¼	¼-½	½-1	1-1½	1½-3	3+
1	2	3	4	5	6	7	8	9	10
				Percentage of all knots					
Virgin	Log run[1]	3.80	0.81	30.2	19.4	22.6	13.7	12.8	1.3
Second	Log run[1]	5.68	1.10	6.4	19.4	29.4	23.0	20.4	1.4
Virgin	B and Better	.03	.24	82.6	13.0	4.4	—	—	—
Virgin	No. 1 Common	.73	.50	42.5	25.3	20.4	9.2	2.6	—
Second	No. 1 Common	1.16	1.09	9.2	16.8	26.0	26.6	21.4	—
Virgin	No. 2 Common	6.33	1.00	12.9	19.8	28.6	19.8	18.2	.7
Second	No. 2 Common	7.16	1.07	6.7	20.6	29.8	22.6	19.2	1.1
Virgin	No. 3 Common	5.49	1.36	7.5	14.8	26.7	17.2	27.1	6.7
Second	No. 3 Common	5.50	1.53	1.2	8.4	26.4	24.9	33.1	6.0

[1] No. 3 Common and Better, a weighted average.

If, as has been reported, the hand-pruning of second-growth white pine in New England is profitable, the hand-pruning of second-growth shortleaf pine should be more so. Recent studies show that shortleaf pine has only about one-third as many knots as the white pine, and therefore the actual amount of labor and cost involved in pruning would be smaller particularly also because labor costs are lower in the South than in New England.

Other things being equal, second-growth shortleaf pine lumber will be slightly weaker than virgin-growth on account of its larger and more numerous knots. It is probable that second growth has a lower percentage of summerwood, which fact would tend to reduce its strength further. It cannot be expected, however, that this difference in strength alone will suffice to prevent the substitution of second-growth for virgin, at least for uses that consume the great bulk of the cut.

Quality of Knots.—The second-growth shortleaf studied had a larger proportion of good knots and a smaller proportion of bad ones than virgin growth. It must not be forgotten, however, that the knots were more numerous, grade for grade, in second-growth and that the percentage of common lumber was also much higher. Twelve different qualities of knots were recorded in the field, but for the sake of simplicity and to facilitate the analysis they are grouped into three main classes in Table 5. Good or intergrown knots were the most prevalent. Their "rings of annual growth are completely intergrown with those of the surrounding wood" on both sides of the board. Such knots are fixed by growth and nothing short of forcible breaking will get them out of the board. From the standpoint of tight lumber intergrown knots are the least objectionable and common grades admit any number of them with certain restrictions as to size and combination with other defects. Second growth showed a substantially larger proportion of good knots in all

TABLE 5

QUALITY OF KNOTS IN A RUN OF LUMBER FROM VIRGIN-GROWTH AND SECOND-GROWTH COMMERCIAL SHORTLEAF PINE

Type of growth	Grade	Good knots (intergrown only)	Bad knots (decayed, holes, loose)	Doubtful knots (all other types)
		Percentage of all knots		
Virgin	Log run[1]	55.3	5.7	39.0
Second	Log run[1]	62.6	2.9	34.5
Virgin	B and Better	69.6	——	30.4
Virgin	No. 1 Common	55.0	.7	44.3
Second	No. 1 Common	90.2	——	9.8
Virgin	No. 2 Common	57.3	4.6	38.1
Second	No. 2 Common	61.7	1.9	36.4
Virgin	No. 3 Common	43.8	15.3	40.9
Second	No. 3 Common	54.4	15.7	29.9

[1] No. 3 Common and Better, a weighted average.

the grades, which is to be expected because sound tight knots arise from live limbs and because the second-growth was cut from younger and smaller trees which have few dead limbs.

Bad knots include knot holes, loose knots, and decayed knots, the last two being substantially equivalent to holes for all practical purposes. They formed a relatively small class in the lumber examined, but they frequently determine the grade of the board in which they occur because they affect its tightness. With one slight exception, No. 3 Common, virgin-growth had the larger proportion of bad knots in all grades and practically twice as many in the log-run.

Doubtful knots comprised a large class consisting mostly of encased, with small proportions of unsound, broken, checked, and pith knots. An encased knot is defined as "one whose rings of annual growth are not intergrown or homogeneous with those of the surrounding wood. The encasement may be partial or complete." Most doubtful knots hold their places in the board, though this depends somewhat on their size and position, however an occasional one does fall out. In every grade virgin-growth shortleaf had a larger proportion of doubtful knots than second-growth. In the log-run lumber doubtful knots made up 39.0 per cent of the total number of knots in virgin shortleaf as compared with 34.5 per cent for second-growth. The larger proportion of dead limbs in the virgin-growth was no doubt responsible for the larger proportion of bad and doubtful knots.

The tendency of knots to loosen is to some extent a species characteristic. Southern yellow pine is generally considered a comparatively tight-knotted wood. Other things being equal, however, large intergrown knots are more likely to check and large encased knots are more likely to loosen in drying than small ones, and as has been said the knots averaged larger in second-growth. On the other hand, the drier the lumber becomes the more pronounced is the tendency toward the checking and loosening of knots; the greater use of dry kilns at plants sawing virgin timber means that the lumber from virgin shortleaf was probably drier on the average than the other.

Important Defects other than Knots.—The more important natural defects other than knots (shake, decay, worm holes, and pitch defects) were found to be more frequent in virgin-growth than in second-growth, but the opposite was true of defects that occur in seasoning, such as split, check, and stain.

In Table 6 several of the more common and more important defects are listed as well as knots. The figures in Columns 4 to 11 represent the percentage of boards in which the different defects were found. Although knots have already been dealt with in some detail they are included here for comparison and because of their great importance.

It has already been shown that knots were more numerous in second growth, and Column 3 of Table 6 shows that the same was true of other defects in their total number. Considering log-run lumber instead of individual grades, second-growth shortleaf had two defects for every one found in virgin shortleaf.

Among the defects that are chiefly characteristic of mature and over-mature timber are shake, decay, and worm

TABLE 6

OCCURRENCE OF THE MORE IMPORTANT DEFECTS IN A RUN OF LUMBER FROM VIRGIN-GROWTH AND SECOND-GROWTH COMMERCIAL SHORTLEAF PINE

Type of growth	Grade	Average number of defects per 8 ft. board measure	Knots	Shake	Decay	Worm holes	Pitch and pitch streaks	Pitch pockets	Split and check	Stain
1	3	3	4	6	6	7	8	9	10	11
			Percentage of boards in which the defects occur							
Virgin	Log run[1]	4.74	66.7	7.7	5.7	4.2	16.5	43.7	26.8	11.2
Second	Log run[1]	9.84	90.5	2.2	.2	.8	5.9	28.9	32.4	60.5
Virgin	B and Better	1.00	3.4	—	—	—	8.2	36.2	19.4	2.0
Virgin	No. 1 Common	3.39	35.7	.3	4.6	3.4	19.5	55.5	42.7	6.3
Second	No. 1 Common	5.70	31.5	—	—	—	4.6	56.2	57.7	63.0
Virgin	No. 2 Common	8.85	96.4	10.0	4.8	4.5	15.9	44.3	25.8	15.4
Second	No. 2 Common	11.53	94.0	2.2	.2	.5	5.7	26.7	30.1	60.2
Virgin	No. 3 Common	8.13	96.8	18.2	14.5	7.5	18.8	34.0	21.0	9.2
Second	No. 3 Common	10.40	89.3	4.1	—	4.1	9.9	35.5	41.3	62.0

[1] No. 3 Common and Better, a weighted average.

holes. Naturally these defects were found more frequently in virgin shortleaf than in second-growth, and this was true of all the grades in which the defects are permitted.

Virgin shortleaf (log-run) had three and one-half times as many cases of shake, twenty-eight and one-half times as many of decay, and five times as many cases of worm holes as second-growth. Although it is not apparent from Table 6, the occurrence of worm holes and shake in virgin shortleaf represented in most cases a more extreme condition and involved a larger portion of the boards containing them.

In every grade pitch and pitch streaks were more frequent in virgin-growth. The reason is not apparent, but possibly it may be a difference in the degree to which the two types had suffered fire damage. The log-run figures also showed more pitch pockets in virgin shortleaf, although a grade for grade comparison was inconclusive. Pitch defects, together with others, such as knots, shake, and decay, which are found in the standing timber, may for convenience be termed natural defects.

Split and check that occur in seasoning were found to be much more common in second-growth than in virgin-growth. They are partly subject to control, since their frequency varies considerably with the care and the skill used in drying as well as with the species. How much virgin-growth and second-growth shortleaf differ in susceptibility to split and check as a result of different rates of growth, percentages of summerwood, and other characteristics, is not definitely known, but the lumber trade generally considers the second-growth to be somewhat more susceptible. The figures in Column 10, Table 6, appear to support this contention. Assuming that second-growth shortleaf is more subject to splitting and to checking it still seems probable that the difference in the amount of split and check in the two types must be attributed partly to the human element in the drying process. Although it is true that kiln-drying is usually more conducive to seasoning defects than air-drying, and the virgin-growth was largely kiln dried whereas the second-growth was air dried, yet the care and skill exercised in seasoning at the large virgin-growth mills were so great, in comparison with the air-drying mills, that they undoubtedly helped materially to reduce the seasoning defects.

The proportion of sap-stained boards was immensely larger in second-growth than in virgin-growth shortleaf. To be sure the second-growth had nearly twice as much sapwood and therefore a larger area was more susceptible to sap stain. Nevertheless, although stain is largely subject to control, almost the only efforts to avoid it, either through kiln-drying or through the use of a chemical dip, were made at mills sawing virgin timber. As a result second-growth showed more than five times as many cases of stain. The entire sapwood was solidly stained in some boards and occasional pieces that would otherwise have graded B and Better were necessarily put into the common grades because of large areas of heavy stain.

Possibilities of Improving the Quality of Second-Growth Shortleaf

Some of the second-growth lumber

certainly came from trees too small for profitable cutting. If these had been allowed to become larger an increased yield of the better grades would have resulted as well as an increase in heartwood content. The extent to which it is practicable to control the size, number, and quality of knots by regulating growth conditions is problematical, but the possibility is worthy of mention.

Split, check, and stain are to some extent subject to the lumberman's control. Greater care in seasoning, involving possibly the greater use of kilns or chemicals dips, will bring about substantial improvement as far as these defects are concerned.

Conclusions

When lumber from virgin-growth and lumber from second-growth are compared grade for grade much, perhaps all, of the superiority of the virgin-growth disappears. Many intangible factors enter into the question of which is better. Each has certain definite advantages, as has been shown, and each has certain specific uses for which it may be preferable to the other. Taking everything into account, it is not at all certain, for practical all-around use, which one has superior utility value. Such superiority may exist, but with shortleaf pine, at least, the existence remains to be proven.

Although the following specific conclusions were drawn only from the lumber studied, they are supported by similar data obtained in other studies:

1. Virgin-growth shortleaf pine lumber had nearly twice as large a percentage of heartwood as second-growth.
2. Lumber from second-growth shortleaf pine was coarser in grain, having two rings for every three in virgin-growth.
3. Virgin shortleaf lumber had fewer and smaller knots.
4. Second-growth lumber had sounder and tighter knots.
5. Second-growth lumber had fewer occurrences of shake, decay, and worm holes.
6. Virgin-growth lumber had more pitch defects.
7. Seasoning defects, split, check, and stain were more frequent in second-growth lumber.
8. In general, as second growth forms more and more of the annual lumber cut, a smaller proportion of select grades and a larger yield of sound, tight-knotted common lumber may be expected.
9. The forester can improve the present quality of second-growth lumber by controlling growth conditions, especially the degree of stocking.
10. The lumberman can improve the present quality of second-growth lumber by using greater care in seasoning.

THE CHEMICAL COMPOSITION OF WOOD OF *TROCHODENDRON ARALIOIDES*

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In classifying natural phenomena, scientists frequently come across border-line cases which test their ability to bring order out of chaos. In this article the author applies a chemical test to check the classification of an exotic wood whose structure possesses both hardwood and softwood characteristics.

TROCHODENDRON aralioides L. and Z. is an evergreen tree native in Formosa and Japan. Although this species is universally classed by botanists as a hardwood (angiosperm) the structure of the wood is intermediate between that of the hardwoods and softwoods (gymnosperms) in that the rays are several cells wide, a characteristic of most hardwoods, and the vessels are entirely absent, a charactristic of softwoods. Moreover, the form, structure, and arrangement of the tracheids closely resembles that of the softwoods.

Analyses of wood of a large number of other species (1) have shown that the chemical composition of the gymnosperms differs from that of the angiosperms in several constituents. The acetic acid and methoxyl contents are generally higher and the ether extractives lower in hardwoods than in softwoods. The most striking difference, however, is in the pentosan content. The wood of coniferous trees contains on the average about 8 to 9 per cent pentosans, whereas that of hardwood trees shows a pentosan content of about 18 to 20 per cent. Furthermore, it has been found that Mäule's reaction (2) (reddening under action of potassium permanganate, hydrochloric acid, and ammonia) gives a deep red color only in case of angiosperms, while with gymnosperms a brown coloration is obtained (3).

The purpose of the work reported here was to determine by a typical chemical analysis and by Mäule's reaction whether *Trochodendron aralioides* should be classed, at least from the chemical point of view, as a hardwood or as a softwood.

EXPERIMENTAL WORK

A piece of wood of *Trochodendron aralioides* was cut into sawdust, ground, and sieved; all particles which passed a 60-mesh screen were used for the chemi-

[1] The writer expresses with pleasure his obligation to L. F. Hawley, A. Koehler, E. Gerry, and E. C. Sherrard, of the Forest Products Laboratory, for their help in carrying out the analysis and to I. W. Bailey, of Harvard University, for the suggestion of the work and for the samples of *Trochodendron aralioides* analyzed.

[2] Maintained at Madison, Wis., in coöperation with the University of Wisconsin.

cal analysis.

The analytical procedure was that accepted in the Forest Products Laboratory (4). A slight change was made in the cellulose determination. The sawdust was extracted with a benzene-alcohol mixture (2:1), washed with alcohol and water, and chlorinated for five-minute periods until all lignin was removed. After each chlorination the sample was acidified with a sulphur dioxide solution, washed, and treated with a 2 per cent sodium sulphite solution in a boiling water bath. The amount of chlorine consumed was not measured, but the chlorine flow was kept constant at a rate of about 120 bubbles per minute. After the final treatment with sodium sulphite, the isolated cellulose was washed with hot water until alkali free, then with alcohol and ether and dried at 105° C. No bleaching was undertaken. Instead of determining the alpha, beta, and gamma cellulose, the hydrolysis number of the isolated Cross-Beven cellulose was determined, as elaborated by Hawley and Fleck (5).

The Mäule reaction was carried out according to Schorger (6). For comparison, Mäule's reaction was studied simultaneously on white fir (*Abies concolor* Lindley and Gordon), white ash (*Fraxinus americana* Linnaeus), and *Trochodendron aralioides.* The results of the chemical analysis are presented in Table 1. The small amount of material available did not permit check analyses in all cases.

Table 1 shows clearly that the sample under consideration has the typical chemical composition of a hardwood.

The pentosan content of the wood, 20.46 per cent, indicates that it is decidedly the angiosperm type, since generally the pentosan content in softwoods varies from 5.5 to 11.0 per cent, while hardwoods have been found to contain from 15 to 25 per cent of pentosans.

TABLE 1

CHEMICAL COMPOSITION OF *Trochodendron aralioides*

(All figures on the oven-dry basis of the wood)

Kind of test	I	II	III	Average
	Per cent	*Per cent*	*Per cent*	*Per cent*
Moisture air dry	7.33	7.48	—	7.42
Cold H_2O extract	2.48	—	—	2.48
Hot H_2O extract[1]	.69	—	—	.69
1 per cent NaOH[2]	21.10	—	—	21.10
Benzene-alcohol extract[3]	3.50	3.42	—	3.46
Ether extract	.75	—	—	.75
Lignin	27.79	—	—	27.79
Cellulose[4]	53.88	54.19	—	54.04
Total pentosans	20.45	20.40	20.52	20.46
Pentosans in cellulose	12.35	—	—	12.35
Hydrolysis number of cellulose	12.62	—	—	12.62
Acetic acid by hydrolysis	7.58	7.23	—	7.42
Total methoxyl	6.70	—	—	6.70
Methoxylin lignin	4.89	—	—	4.89
Ash	.746	.746	—	.746

[1] After subtracting cold H_2O extract.

[2] After subtracting hot and cold H_2O extract.

[3] The solution in benzene-alcohol had a very bright color.

[4] Required 4 chlorinations of 5 minutes each.

Correspondingly, the pentosan content of the isolated cellulose is high, and the cellulose here contains actually more pentosans than the total wood of the softwoods. Usually hardwoods give a higher yield of volatile acid on hydrolysis than do the softwoods (7), and, indeed, the amount of volatile acid obtained with *Trochodendron aralioides* is, so far as the author is aware, the highest ever obtained. Incidentally, it was observed that throughout the work with this wood all filtrates, water as well as alcohol-benzene and alkali, showed a very marked capacity to foam. The scarcity of material, however, did not permit any investigation of the cause of this phenomenon. The methoxyl content of softwoods (about 3.9 to 5.5 per cent), is appreciably lower than that of hardwoods (about 5 to 7 per cent); *T. aralioides*, therefore, shows also in this component a characteristic of a hardwood.

The Mäule reaction was studied, as indicated, on three species; namely, white fir, which is a typical softwood, white ash, which is a typical hardwood, and *Trochodendron aralioides*. *T. aralioides* gave a deep cherry-red color, more pronounced even than the white ash. White fir gave, as expected, only a brownish coloration.

Remarks on the Mäule Test

Lignified tissue from hardwoods, when treated with a 1 per cent solution of potassium permanganate, washed and treated with hydrochloric acid, becomes red upon addition of ammonium hydroxide (2). Practically the same reaction takes place, as observed by the author on about twelve species, during the chlorination process in isolating Cross-Bevan cellulose. The acting agents here are chlorine and the sodium sulphite solution. In all cases studied, the hardwoods gave with this reaction always red coloration, identical in shade with Mäule's test, whereas the softwoods yielded always a brown color. A study of the literature revealed that Mäule's test is a special case of a general reaction in which not oxidation, but chlorination, or possibly chlorination in addition to oxidation, is essential in the production of a substance which subsequently turns red upon addition of an alkali. Vincent (8) found as early as 1849 that fibers of *Phormium tenax* turn bright red when treated with a saturated solution of chlorine, washed, and subsequently treated with ammonia. Again Cross and Bevan (9) and Webster (10) found that a red color was produced when wood tissue was treated with chlorine and sodium sulphite.

In Mäule's reaction potassium permanganate is reduced by some oxidizable material of the tissue to brown manganese dioxide. This in turn generates chlorine from the hydrochloric acid added, which combines with some organic substance as in the preceding tests to a chlorinated product. This product turns red upon addition of an alkali, in Mäule's test, ammonium hydroxide. Oxidation alone does not suffice to produce the red colored substance; for example, Lamarliere (3) found that a good and distinct color appeared only with Mäule's original reagents or when Hoffmeister's reagent (potassium chlorate with hydrochloric acid), rich in chlorine, was used. Ammonium hydroxide, on the other hand, could be replaced and potassium carbonate and

other alkalis were successfully applied. Similarly E. Siersch (3) did not succeed in substituting Mäule's oxidizing agent either with chromic acid or hydrogen peroxide. It is, therefore, assumed that Vincent's, Cross-Bevan's, and Mäule's reactions are essentially identical—chlorination, or possibly chlorination with oxidation of some substance in the lignified tissue, and subsequent colorization by means of an alkali. A similar view has been expressed by Hawley and Wise (11).

Summary

Chemical analysis of wood of *Trochodendron aralioides* L. and Z., as well as the Mäule test show that it corresponds fully with the hardwood type. The acetic acid content was found to be 7.42 per cent on the basis of the oven-dry wood, which, as far as the author is aware, is the highest ever obtained from a hardwood species.

Vincent's chlorine-ammonia reaction, Cross-Bevan's chlorine-sodium sulphite reaction, and Mäule's potassium permanganate-hydrochloric acid-ammonia test appear to be essentially identical.

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FOREST DAMAGE AND THE WHITE PINE BLISTER RUST

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The science of forest pathology has reached a point where it must emphasize the *forest* instead of the *pathology*, and must attack its problems from a silvicultural point of view and in terms of the mature stand of surviving trees instead of diseased and dead trees. The author develops one aspect—forest damage—of such a mode of approach, using the results from a study of eight plots to give the loss factor.

THE science of forest pathology has made great strides in this country in the last 25 years, largely because of the necessity of studying and combating two serious imported diseases—the chestnut blight and the white pine blister rust. Certainly, too much could not be expected of a science so young, but on the other hand, it is time that a new point of view and outlook became more general in forest pathology studies.

Most such work up to the present has been of the nature of forest mycology or *tree* pathology. The major emphasis in forest pathology has been upon the *pathology* and not so much on the *forest.* Attention has been centered upon the study of disease conditions in the individual trees, in reference to dead and diseased trees, and not in terms of the surviving trees, the future forest. The study and estimation of damage continue to be spoken of in terms of percentage of infection and the concept of loss in the ultimate stand has been too sparingly adopted. This is the more to be wondered at, because Meinecke some little time ago emphasized the need for a new outlook in forest pathology and pointed the way, and has since been setting the example in his admirable studies of certain forest tree diseases (1, 2, 3, 4).

Forest Damage

When the writer began his work in New York in 1923, the customary manner of expressing loss or damage was in terms of percentage of infection. It was soon apparent that this was both inadequate and unscientific. In the first place, obviously the number of trees that are infected has no meaning if many or most of the infected ones survive. It is only those trees which are going to succumb that have any bearing upon the loss problem. Hereupon was developed the concept of "imminent mortality,"[1] which includes the trees already dead

[1]No care has been taken in this paper to maintain a difference in meaning between "imminent mortality" and "ultimate mortality." These phrases here refer to the probable mortality on the basis of disease conditions at the time of writing (1930) whether the stands have been cleared of Ribes or not. "Ultimate mortality" may seem more desirable for lots where the Ribes have been removed, but on the other hand, there is no certainty that Ribes will not reappear in the future and kill more trees.

and those doomed to die before the maturity of the stand. The determination of the doomed trees was largely guesswork in 1923, but sufficient information is now at hand to make these prognostications very reliable.

Calculation of the imminent mortality of a stand is, however, still inadequate. There is no interest in the number of trees upon a lot that are going to die ultimately; the important thing is the number that are going to survive. In many woodlots, the percentage of infection is high, the percentage of imminent mortality is high, but the damage is little or nothing. One well-known pine lot of slightly over-mature trees has a high percentage of imminent mortality, but the trees now dead are still usuable for lumber purposes, and the remainder are ready to be cut. There is a great deal of disease in the lot, many trees are dead, but the crop is mature, the trees are all there, and if the owner will cut, he will get his compensation with no loss whatever. On another lot of sapling pines studied by the writer, the percentage of infection is high, the mortality is nearly the same, but after all the diseased trees die, there will still be 1000 trees an acre left to make an excellent stand.

With these foregoing facts in mind, methods were developed for the purpose of making reasonably accurate estimates of the "loss" or "damage" factor in pine lots affected by the blister rust. These methods have been in the process of formulation and improvement during the past six summers and it so happens that they approximate in general and in many particulars those developed by Meinecke in his studies of another rust on the Pacific Coast (3). In fact, while the general procedure was instigated independently, it is only fair to state that the writer had access to Meinecke's original manuscript in 1926, and is indebted to his paper for many suggestive ideas.

The technique employed in the studies of damage caused by the white pine blister rust in the Adirondacks comprises three phases: 1. the accumulation of infection and mortality data upon trees; 2. mapping of the plot, with accurate placing and symbolic description of each tree; 3. study of the note and map data for the estimation of the damage.

Infection and Mortality Data

The notes are taken upon form sheets and consist of all facts that can be obtained relative to the condition of the tree and its pathology, and its future, including the following items: age and size; condition of crown; abnormal conditions caused by insects, other diseases, or its environment; infection conditions, such as position and size of cankers and their longevity, etc.; and finally, the results of a study of these facts, and a study of the tree and its environment with a definite statement as to the likelihood of its succumbing or surviving, and its probable value to the stand.

Mapping

The experimental lot is first laid out with white twine into quadrats of 50 feet. The map on cross section paper is made in the field as the study progresses. Not only is each tree placed as accurately as possible with respect to its neighbors, but the size of each is repre-

sented in scale. Different symbols are used to denote not only such pathological conditions as "dead," "doomed," "infected but will survive" and "not infected," but also other facts bearing upon the likelihood of the tree's contributing to the future stand.

This map shows then the following: what trees will remain to make up the stand, in relief against what were available originally for a stand; the sizes and crown conditions of the survivors, and therefore, some hint as to the value of each tree for lumber when mature; the diminution in area of the forest cover because of the disease.

In addition, lines are drawn representing the crown covers of the stand showing potential area covered if undiseased against the probable area covered as now affected by the disease.

Estimation of Damage from Notes and Map

The estimation of damage caused by a disease is naturally fraught with difficulties. With all the factors not completely known, some perhaps not even suspected, and with no possibility of allowing for future contingencies and the vicissitudes of growth and change, at best it is but guesswork. All such work suffers the usual defects accompanying the attempt to reduce a biologically dynamic condition to statics. The mitigating excuse is that something of the sort is necessary; anything of the sort is preferable to persistence in speaking of disease conditions in terms of percentage of infection or even in percentage of imminent mortality.

In this estimate of damage, the following conditions of the stand were given consideration.

1. *Reduction of the number of trees by the disease.* It is necessary to know whether the ravages of the disease will leave enough trees for a good stand. The relation of this number to the age of the stand is important.

2. *Reduction of area of forest cover by the disease.* In his pioneer study of the damage to western yellow pine by another rust, Meinecke (3) has used the reduction of the forest cover by the disease as the main criterion of the loss factor. This reduction is figured on the basis of loss of trees dead or fatally infected ("doomed" in this paper) at the time of the study, allowing for each tree a crown spread of a diameter equal to half the height of the tree. In the writer's study of the white pine blister rust, this type of estimate has not been attempted. Attention has been directed to the future mature stand in which the crown area and the forest cover have been estimated in terms of matured trees. An inspection of Figure 1 shows a great discrepancy between the losses as indicated in terms of reduction of forest cover at maturity and in terms of potential board feet production. In many of the plots studied where there was certain to be considerable damage by the rust, the reduction of the area was negligible. In some cases, the blister rust fungus kills entire groups of trees but the groups are usually small. Most of the destruction is more or less uniform over the lot, and the trees left to survive are well distributed over the area (see McCormick, Kelm Mountain, Whalen and Downes lots).

3. *Kind of trees left.*

a. Crown development. It has been

found that the blister rust fungus is more likely to infect dominant and healthy trees than suppressed or sickly ones in about a 2 to 1 ratio. In some lots, this difference is not so pronounced and has less influence upon the make-up of the future stand. In others, however, such as the Whalen lot, the loss of the largest, best and healthiest trees and the survival of the spindling and suppressed trees is of great importance in any damage survey. In any case, the maturity of the stand may be delayed several years (estimated at from 10-15 years in the Whalen lot) and further, there is no certainty that all these weakened uninfected trees will survive until the death of their overtopping diseased neighbors (see Whalen lot).

b. Trees otherwise injured by insects, storms, and other causes. Many surviving trees are bent, double-trunked, multiple-topped because of weevil, snow-broken, injured by insects, etc. Account must be taken of such conditions.

c. Branchiness, and the like. Such facts as poor logs, short logs, and the like, must be considered.

4. *Spacing of trees.*

a. Value of lumber to be produced. There is no need of discussing the importance of this matter. In some lots, the trees left by the disease make a fine stand (cf. McCormick lot). In others, too few are left to make good trees, as in the Downes lot, where many of them are not being forced and will become short and branchy. The arbitrary standard crown selected for use here was one of 25 feet diameter, on the basis of 500 trees to the acre at 50 years on a good (*i. e.*, without blister rust), the other of site.

b. Loss of trainers. Many trees which can be spared in the future stand for lumber production will not be missed at all—in fact, would have to be thinned out anyway. Others of these are necessary as trainers for a period of years. The loss factor here varies considerably. If a tree which is doomed to die will survive until it is 25 years of age and will have performed its duties as a trainer, there is no loss. If it is dead already or will die shortly, it is a loss because it does not help its neighbors. The mortality data as to age of infection, probable date of death, are indispensable here. In the Dannemora plantation, consideration of these points was of great importance.

With the foregoing considerations in mind, the estimate of damage is made. Various methods have been tried. The most satisfactory one to date comprises a balance of two estimates—the one of the potential lumber production as it would be were all the trees undiseased the probable lumber production without the trees removed by the blister rust.

The first estimate is made on the lot (and with the aid of the map if desired) by an experienced forester if possible. This estimate is in terms not only of the potential board feet of lumber production under the given conditions, but also of quality of lumber likely to be obtained.

The second estimate is made by a study of the pathological map, checked by observations on the lot. Here the spacing of the surviving trees, their ages and crown development, their opportunity to grow, their general condition, and similar factors come into the consideration of the probability of lumber

production. It is assumed that a relict stand of 20 to 22-year-old dominant trees spaced about 6 to 10 feet (600 to the acre) will give a normal production of lumber. Therefore there is no loss. This condition prevails on the McCormick lot. On the other hand, if there are only 100 or fewer trees to the acre, we must consider not only the number of trees and the amount of lumber produceable per tree, but also the spreading character of the trees, and the small number, shortness, and knottiness of logs (see Downes lot). If the relict trees are of uneven age, size and crown development, consideration must be given to these facts in the estimate.

In the McCormick lot, the estimate is simple. In other lots it is more difficult. Various mechanical devices may be of assistance. Outlines of the potential or probable crown development of the surviving trees on the map have assisted. Roofing nails or tacks placed bottom up on the maps to note the positions of the surviving trees have proved helpful in the study.

A balance of the two estimates arrived at in these ways then gives the damage factor in loss of board feet to be sustained. This loss can be expressed in percentage as "probable loss" or "damage percentage." At any rate, anything but "infection percentage" or "mortality percentage" when attempting to talk in terms of forest pathology.

Studies of Blister Rust Damage in the Adirondacks

A paper which has already appeared in this Journal (5) reported the basic infection and mortality data of the damage studies. The following discussion will include the essential data upon the new plots and check data upon the old plots from the observations of the past two or three years, and will add the estimates of damage or loss as made upon the basis of these data and in accordance with the principles presented above.

Kelm Mountain Plot
Warrensburg, Warren County

The Kelm Mountain plot is a classic of blister rust damage. It is therefore being given special treatment in another article and only essential details will be presented here.

Of the 1130 trees in 2 acres, 96 per cent have been infected. Sixty-nine per cent are now dead and 18 per cent now are doomed to die, making an imminent mortality of 87 per cent.

It was estimated that this stand undisturbed would have produced from 60,000 to 70,000 board feet of lumber. There will now be left only 107 trees on 2 acres and the damage is therefore complete. In fact, this promising pine stand is now actually a hardwood stand.

Dannemora Plantation
Dannemora, Clinton County

The Dannemora Plantation on the prison property was of interest because of: 1. the apparently high percentage of infection and serious damage done, 2. the novelty of so much damage in the presence of *Ribes triste*, and 3. the possibility of the relation of altitude (2059 feet) to infection and damage. The plantation is of about 2.25 acres and has 2211 trees 16-years-old planted for the most part 3 by 3 feet, but very irregularly. The Ribes were eradicated in 1927.

Of the 2211 trees, 1166, or 53 per cent, are infected. Only 71, or 3 per cent of all the trees are now dead, but 1066, or 48 per cent, more of the trees are doomed. This makes an ultimate mortality of this lot of 51 per cent of the total number of trees. Ninety-seven per cent of the trees infected are doomed because they became diseased when they were between 6 and 10 years of age (see 5, p. 478 and 6, p. 277).

It was estimated that this plantation, undisturbed by the blister rust, would have produced at maturity about 650 good trees and 80,000 board feet of lumber on the two acres. Under the present conditions of infection, there will probably be left about 500 good trees producing 50,000 board feet of lumber. This makes a loss of lumber production of 37 per cent.

Whalen Plot
Town of Chesterfield, Essex County

The Whalen Plot is back in the mountains in a large area of badly diseased pine. Out of 955 trees from 15 to 30 years of age on the lot, 405 are now dead (387 from blister rust) and 134 more are doomed. In all, 521 will eventually be removed by the blister rust, a mortality of 56 per cent.

With these trees removed by blister rust, there would be left 416 trees on the lot, 259 of which are suppressed and 157 dominant. But of these, 105 will not survive because of shading, or other reasons.

This leaves 311 trees for the lot, 150 of which are now suppressed and 161 of which are dominant. Of the 161 dominants, 13 are below 22 years of age and 137 over 22—about 150 of them good trees. Of the 150 suppressed trees, 130 are over 22 years of age. These, seriously delayed in growth, are the ones to take the places of good dominant trees removed by the blister rust.

Most of the surviving trees (and half of these suppressed) are rather closely packed in less than one-quarter of the acre. These trees will ultimately make a good patch, but the number will be reduced to about 75 good trees and their maturity is already delayed at least 10 years. The remaining trees are scattered over the remainder of the lot, and inasmuch as they are nearly all isolated, they will make short branchy trees with poor lumber.

In other words, a stand of 955 trees reasonably evenly scattered over this acre would have made a fairly good stand of pine. The inroads of the blister rust have reduced the number of trees to too small a number per acre, have reduced the area of forest cover, removed a large proportion of the dominant trees and left a large proportion of the suppressed trees, and isolated the best surviving dominant trees, so that they will make poor lumber.

A stand that might reasonably have been expected to yield from 35,000 to 40,000 board feet of good lumber at 50 years of age will now yield not more than 10,000 feet, much of it of poor quality.

Downes Plot
Peru, Clinton County

The Downes Plot is in a typical pastured pine lot, in good pine country. At the time of the first study there were 474 trees, from 23 to 30 years of age, on about three-quarters of the acre (density

of 600 an acre), a good woodlot stand.

At the present time, 182 of the trees are dead from blister rust attack and the estimated mortality is 52 per cent. There will be left on the lot 175 trees, and 50 of these will probably be shaded out before the stand is mature.

The original pines, if left undiseased, would have covered about three-quarters of the acre lot. The future cover will be about three-fifths of the acre, a reduction of cover by the blister rust of about 18 per cent.

There will thus be 125 trees covering three-fifths of an acre (a density of 205 per acre). Most of these are dominant or intermediate trees. Twenty of them are 27 years of age or over, and the remainder are between 20 and 27 years. At the present time 31 are out in the open alone and are short and branchy. Most of the remaining trees will be of this type.

At 50 years the original stand of 474 trees would have made only a fair stand having 175 trees well spaced (30 of these quite branchy). These might have yielded 20,000 board feet of lumber.

As it is now, the 125 trees to be left at maturity will all be branchy because of lack of trainers and will probably yield less than 10,000 board feet of lumber, more likely around 7,000 feet. The loss in board feet is therefore likely to be 65 per cent.

Sternberg Plot
Central Bridge, Schoharie County

This plot was of interest because of the large amount of seedling stock beneath a few old trees. Of the 3530 trees on four-fifths of an acre (all but 50 under 20 years of age) 890 or 25 per cent are now infected, 709 or 21 per cent are dead, 353 or 10 per cent are doomed, making an imminent mortality of 31 per cent.

As to the damage upon this plot thus far, it is clear even though over 1,000 trees are dead or doomed, that the remaining 2500 are still more than enough to make a stand unless hit soon by a blast such as that which hit many places in 1919. The word "soon" is used because all the time these trees are growing older and hence correspondingly less likely to be killed, especially as the stand is so thick as to kill out many branch cankers (see 5, p. 478—6, p. 277).

The damage then thus far is nothing.

Horicon Plot
Horicon, Warren County

The Horicon Plot is a side-hill stand bordering a pasture and traversed by cowpaths, but itself pastured little. It is next in interest to the Kelm Mountain Plot for the reasons stated previously. In addition, a better knowledge of its history has provided several facts as a basis for study. It is known, for example, that there was not a dead tree upon the lot in 1920. Also, it is known, that there were thousands of seedlings on the lot prior to and including 1920, which were not found at all, dead or alive, in 1923. The trees are of all ages, but the larger number are now between 16 and 25 years of age.

There are now 1035 trees upon this lot. In 1923 there were 1351 trees. Most of the missing trees were seedlings. It is not known what the cause of their disappearance was and even though the blister rust, without doubt, accounted

for the death of many, they are left out of consideration here. As to the gross data upon 1035 trees, 613 or nearly 60 per cent are infected, 503 or nearly 49 per cent dead, 48 or 5 per cent are doomed and the imminent mortality is therefore 54 per cent.

It is more significant, however, to consider these data in reference to the age classes referred to above, for the same reasons. Not only are most of the trees in the 16-25 year age class, but more important, this is precisely where the greatest damage is. Only 73 per cent of the trees are in this age class, but 90 per cent of the dead trees on the lot are here, along with 87 per cent of the doomed trees and 85 per cent of the imminent mortality.

Now let us turn to the trees that will survive to the maturity of the stand. Of the 231, 43 are badly suppressed, leaving 188 dominant and intermediate trees. Of these 188, 63 are under 16 years of age—rather small. Forty-two are 26 years of age or older. They are short, spread-out, branchy, and will produce one or two logs, perhaps short ones. Only 83 out of the 437 dominant and intermediate trees between 16 and 25 years of age will survive.

Here is the situation then. Whereas there now ought to be 1035 trees in all, with 437 dominant and intermediate trees between the ages of 16 and 25 years (1930), there will be left after the ravages of the blister rust only 484 trees in all, of which as stated above, there will be only 83 dominant and intermediate trees of the 16-25 years age class, with some smaller and larger and some suppressed trees to the number of 148 to bring them along. The ravages of the blister rust will leave 484 trees, but 253 of these will die out because of shading or other causes.

There is no reason why the original stand would not have yielded 45,000 to 50,000 board feet at 50 years. Because of blister rust attack, the remaining 83 good trees reasonably well trained and the 42 older isolated, branchy trees will probably yield not more than 10,000 board feet. The loss in board feet will be about 80 per cent because of blister rust attack.

McCormick Plot
Keeseville, Clinton County

This plot is a half acre of 1116 trees, a fine stand of saplings, 22 to 24 years of age, on a hilltop of several acres of similar growth.

Of the 1116 trees, 593 are badly suppressed and most of them dead by shading. Of the remaining trees, 377 are of the dominant class and 146 intermediate. Of the total, 298 or 27 per cent are infected, 150 or 13 per cent dead, and 128 more (12 per cent) doomed. The imminent mortality is nearly 26 per cent. This latter figure is not large; in fact it strikes one as surprisingly small after an inspection of the lot. This is because a casual inspection does not note the 431 small, badly suppressed trees which have been shaded out. Without these trees removed by shading, the mortality is 42 per cent, which is more in agreement with the impression of destruction obtained.

An interesting feature of this lot is the predominance of stem cankers. Because of the lodgepole type of growth, branches are short and small, and at present nearly all the cankers are in the stem.

Another unusual feature is the location of these cankers, 8 to 15 feet from the ground.

It was found that there will be 370 trees surviving the blister rust, shades, etc. One hundred and thirty-eight more trees (the 138 doomed trees) are still alive and will survive for a varying number of years to help bring the healthy ones along. There are also 8 more, which are still alive now, that for one reason or another will not survive.

That makes over 500 trees now alive on the half acre (1000 to the acre) at 20 to 25 years of age. Here are enough trees to produce a good stand if they are properly spaced. A map made to picture the positions of surviving trees shows that the spacing is admirable, that the trees removed by the blister rust are well-scattered and that no surviving tree is more than 8 feet from any of its neighbors.

In other words, in a fine sapling stand where the effects of the blister rust are unusually striking, where the mortality percentage is 25 per cent or 42 per cent as one desires to figure it, the actual damage or loss is precisely zero. Nothing but a beneficial thinning has been accomplished, and there are enough dominant trees well spaced to provide a magnificent stand of timber.

Furthermore, even if the Ribes in this area had not been eradicated, the damage to this stand through future infection would be slight. While new Ribes were becoming established and growing to a size large enough to become a source of danger to these 25-year-old trees, the stand is becoming older and therefore less likely to suffer material damage from blister rust attack, especially where the Ribes are below the level of the tops of the trees (cf. 5 and 6 as referred to twice previously).

McPhillips Plot
Pack Forest, Warrensburg, Warren County

The McPhillips Plot is an acre of typical pine stand of all ages up to 55 years, located on the Pack Forest belonging to the New York State College of Forestry. This plot has been studied 3 times between 1923 and 1930 and in all, 2585 trees have been tagged. Of these, 1241 or 48 per cent have been found infected at one time or another, 26 per cent dead and 12 per cent doomed, making a total damage of 38 per cent from blister rust.

In 1930 only about 1550 trees were located upon the plot meaning that about 1000 trees have disappeared in the last 7 years. Only a few of these latter trees were diseased; most of these were small trees, either of the lower age classes or badly suppressed. Of the 1550 trees remaining, 674 are already dead and 176 more will die from blister attack. A few more are already dead or will die from other causes and there are now left 1616 trees suffering from no apparent disabilities. Three hundred and sixty-five of these are suppressed and 251 are normal as to development. Many of the dominant trees and most of the suppressed trees will be shaded out.

There are several large spreading trees from 30 to 55 years of age and there are 2 or 3 open spaces in the acre. The large trees and the open spaces occupy 39 per cent of the area.

The available three-fifths of the acre

originally had over 500 good trees between 15 and 30 years of age, enugh to make a good stand of pine. Underneath this, there would have been over 2000 smaller trees under 15 years of age. This available three-fifths of the acre is now occupied by about 100 dominant undiseased trees between 15 and 30 years of age and 500 good trees under 15 years of age, or badly suppressed, if over. This is at a rate of 165 dominant surviving trees to the acre with something over 800 smaller and suppressed trees an acre beneath.

This plot, which might have produced 30,000 board feet of good quality lumber if undistributed by the blister rust will now yield 7500 board feet or less, and that of poor quality. The blister rust has caused the loss of at least 75 per cent as far as board foot production is concerned and a greater loss from a pecuniary point of view.

Infection and Damage Data

As a matter of convenience and for what information may be obtained, the main facts gleaned from the studies of damage upon the heretofore mentioned plots are presented in a graph in Figure 1.

There is no correlation between the percentages of infection, of imminent mortality, and of loss in board feet. The loss in board feet parallels the percentage of mortality for four of the plots and is higher in these cases, but for the other three lots—the loss percentage falls below, to zero in the latter two plots. In the Sternberg Plot, there would be a greater discrepancy if the mortality per cent were higher, as it might reasonably be, for there would be no loss here even with a very high mor-

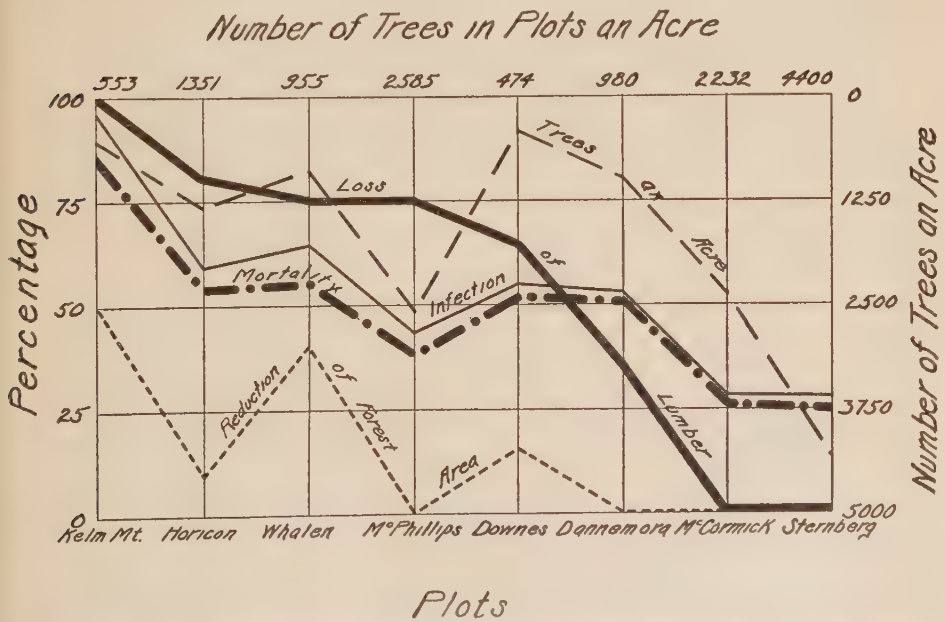

Fig. 1—Graphical representation of pathological data obtained from the study of white pine blister rust damage in New York State.

tality, in view of the 3500 trees on the area.

Percentage of infection or even of imminent mortality is therefore not a reliable index of actual loss.

Summary

The science of forest pathology has reached a point in its development where it can and must emphasize the *forest* instead of the *pathology*, and must attack its problems from a silvicultural point of view and in terms of the mature stand of surviving trees instead of diseased and dead trees.

Only one aspect of such a mode of attack is developed in this paper—forest damage. The general procedure of estimating damage as used in studies of the white pine blister rust in the Adirondacks is elaborated.

The damage data obtained from a study of eight plots are given, with the loss factor in terms of board feet. It is shown that there is no correlation between percentages of infection and imminent mortality, and percentages of loss in board feet.

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THE ROLE OF DISEASE IN THE GROWING OF POPLAR[1]

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Oxford Paper Company, Rumford, Maine

Poplar, once important only for shade or windbreak purposes, has taken on new consequence because of its pulpwood possibilities. Forestation with poplar directed attention early to the importance of certain parasitic diseases that attack it. The author discusses these diseases, their relative virulence on different species and measures for their control.

POPLARS are usually spoken of as short-lived trees, yet there are poplars well over 150 years old, as for example the wild necklace poplar (*P. balsamifera virginiana* [L] Sarg.) called the "Lafayette Tree" at Geneva, New York. However, these are scattered trees and hardly represent the average. It is a fact that poplars such as the *eugenei* and the Lombardy, familiar to all of us as shade trees, are usually short-lived. These poplars have always been propagated vegetatively from cuttings and therefore they exist as clons. Thus all trees of the *eugenei* poplar, commonly called the Carolina poplar, are members of one clon. They have all been derived by vegetative propagation from one hybrid seedling which originated in the Simon-Louis nursery, near Metz, France, in 1832. This common practice of vegetative propagation has led to much speculation on the possibility of the degeneration of a clon over a long period of time. Degeneration resulting from repeated vegetative propagation was early believed to be responsible for the average short-life of some poplars, and this belief, in a somewhat modified form, is still held by some investigators at the present time.

Certain fungi which in the past have been considered as merely of secondary saprophytic occurrence, may often be an immediate cause of the death of poplar trees. There are several important diseases of poplar which have been reported as responsible for severe damage. In Europe *Dothichiza populea* Sacc. & Briard, has long been recognized as the cause of a serious canker disease of poplar. This same pathogene has been reported from various parts of the United States, and it has been reported as responsible for excessive damage to plantations of poplar in Ohio. We have not yet found this fungus in any considerable amount in northern New England. A bacterial canker disease also occurs in Europe, but to date this disease has apparently not been found on this continent.

The most important disease of poplars in the New England area is the canker caused by *Cytospora chrysosperma* Fries. This is the pycnidial stage of the ascomycete *Valsa sordida* Nitschke. This disease is fully discussed

[1] Presented at winter meeting of New York Section, Society of American Foresters, Albany, N. Y., January 31, 1930.

in a paper to be published later this year in the American Journal of Botany. C. Chrysosperma is found throughout the range of poplar in the United States and Canada, and also in Europe. The disease was first described by Long from the Southwest in 1918.

The mycelium of this fungus grows in the bark of the tree and causes the death of the cambium. Small stems and twigs are killed by girdling without any cankered appearance, but where the fungus invades larger branches the dead areas are usually sunken, due to shrinkage of the dead bark and to the growth of the living tissue around the areas. Old trunks and branches with rough bark seldom develop the typical cankered appearance. Numerous sucker shoots often start immediately below a canker on a large branch or on the trunk, many of which soon become diseased and die. Successive crops of such shoots may start each year until the tree has been killed.

Pycnidial fruiting bodies are almost invariably formed on the dead areas. When they are almost mature the pycnidia appear as small pustules under the epidermis of the bark. During damp weather the pycnospores are pushed out through an opening in the centre of each pycnidium in yellowish orange tendrils or globular masses. The spores are very small and colorless, and are held together by a muscilaginous substance. They are washed down the tree and may be disseminated by insects and birds, but probably to a greater extent by wind.

In natural stands of poplar, (*P. tremuloides* Michx. and P. *grandidentata*, Michx.) throughout New England the Cytospora disease is ordinarily more apparent in young stands under 20 feet high. The fungus is just as prevalent in the older stands, but it is usually in the tops, and on the upper parts of the trunk. Examinations have been made on poplar slash in many pulpwood cuttings in Maine, New Brunswick, and Nova Scotia. In the newly cut tops of apparently healthy trees dead twigs and larger branches are more or less numerous, and pycnidia of *Cytospora chrysosperma* can be found on many of them. *Cytospora chrysosperma* is ordinarily only weakly parasitic. The fungus may live saprophytically on dead twigs, or it may enter through wounds on living parts of the tree. Spread of the disease in the field is apparently chiefly by pycnospores.

So far there has been no evidence of an immune species or hybrid of poplar. It is hoped that some of the many new hybrids recently developed will be entirely immune or at least highly resistant to this disease.

A comparison of immunity or degree of resistance to the disease falls into the following three groups:

1. A comparison of different hybrids or species.
2. A comparison of different seedling individuals of the same species.
3. A comparison of different individuals of the same clon.

Cytospora chrysosperma has been found on all species and hybrids of poplar so far examined. While some kinds of poplars such as *P. simonii* and the Lombardy poplar appear to suffer more from this disease than other kinds, to date we have no definite data upon which an accurate comparison of the

relative resistance of the various poplar species and clons could be based.

We come next to a comparison of seedling individuals of the same species. We have observed that this disease is more severe on some individuals of our native species of poplar. (*P. tremuloides, P. grandidentata, P. tacamahacca,* Mill and *P. balsamifera virginiana* [L] Sarg.) than on other trees of the same species. This might be due to an inherent resistance of the seedling individual. However, it has been observed that the trees upon which the disease is most severe are usually growing poorly, apparently because of a poor site, or injury by wind, frost, fire, and the like. This would point to a direct relationship between the vigor of the tree and the extent to which it is injured by the disease, or to some factor in the distribution of the disease itself. This assumption is in line with our observations on individuals of the same clon.

Our observations with such clons as the *eugenei,* the *regenerata* and the *generosa* poplars, all of which are of hybrid origin, have shown that the same variation of apparent resistance occurs among the individuals of such a clon as among the seedling individuals of the native species. Some individuals, though infected by the disease, have continued to grow without apparent injury, while other individuals of the same clon have been killed by the disease. These differences cannot be explained on the basis of an inherent resistance in the particular individual. They are apparently due to the greater vigor of the individual tree.

It has been observed that where the vigor of the tree drops below normal, due to age or to environmental conditions such as an unfavorable site, climatic conditions, damage by fire or wind, the *Cytospora* present on small twigs encroaches upon the adjacent living parts of the tree in proportion to this reduction in vigor. The results of the following experiment demonstrate how directly the progress and extent of this disease is related to the vigor of the tree itself.

In the fall of 1925 a number of infected one-year-old rooted *eugenei* trees, growing on very poor soil, were transplanted to rich garden soil. These trees grew vigorously during 1926, and the growth each year since then has been better than during the preceding year. The infected trees which were not transplanted all died after a year or two. Other trees growing on this poor site, which were not infected by *Cytospora* grew only six to eight inches a year but remained alive.

Poplars are propagated in the nursery entirely from cuttings which are usually heeled-in for winter storage. Such dormant cuttings are very susceptible to damage by *Cytospora* during this period. Several years ago a fall shipment of 10,000 cuttings was so badly infected by this fungus while in storage that only 20 to 30 living trees were obtained from the entire lot.

Cuttings also show a great variation in the extent of injury by this disease after planting. As in the case of older trees, this does not appear to be due directly to an inherent resistance, but rather to another inherent character, the "rooting quality" of the cuttings. The

native aspens, *P. tremuloides* and *P. grandidentata,* give a catch of less than one per cent in a nursery planting, whereas the *eugenei* poplar roots practically 100 per cent. Other species and hybrids fall between these two extremes. Those poplars which root easily have shown less injury from *Cytospora* during the first year after planting than those which root with difficulty. The cuttings which do not root readily are not as vigorous during the early part of the growing season, and are probably killed by *Cytospora* before they can establish an adequate root system.

From our observations thus far, *Cytospora* canker does not appear to be a very damaging factor in wild stands of poplar in Maine. The greatest amount of fatal infection occurs in young stands, up to eight or ten years old, which are usually overstocked. The early death of a considerable amount of this stock results in a gradual thinning which is decidedly advantageous to the stand. The very nature of the parasitism of *Cytospora* results in the removal of the weaker trees in such a stand and the survival of the more thrifty. In stands over twenty feet high the damage from a practical standpoint is with few exceptions hardly alarming. On the other hand little is known at present of the nature of fungus epidemics, and it is conceivable that at some time a much more virulent strain of this fungus might appear.

In reforestation with desirable fast-growing poplars *Cytospora* may be the deciding factor between success and failure. Direct control measures are possible in handling and growing cuttings in the nursery. Proper storage, at a temperature below 35 F., and the sorting out of diseased cuttings have been found practical in reducing the subsequent appearance of this disease in the nursery.

Direct control is impossible in plantations. The successful establishment of plantations of poplar free from disease injury appears to depend very largely upon obtaining a vigorously growing stand immediately after planting, and maintaining this vigor of growth. It is not enough that the trees should merely live during the first year after planting, because such trees are very apt to be wiped out by disease within a few years. The trees must grow vigorously during the first year and must maintain this vigor.

At present the best means to this end appear to be the following:

1. Each kind of poplar should be planted upon a site favorable to its growth.

2. Only the best planting stock should be used. Cuttings should be not less than one-fourth inch in diameter, and rooted trees with poor root systems should be discarded.

3. Careful planting is necessary in order that the trees or cuttings may not be handicapped at the start. This is a factor which is too often taken for granted.

4. Poplars are very sensitive to both root and top competition. For this reason plantings should be made immediately after logging and clearing of weed trees, so that the planted poplar may have a start at least equal to that of the young wild growth, and finally, sod land should be avoided.

OREGON REFORESTATION TAX LAW

By H. J. EBERLY

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The State of Oregon has not waited until most of its virgin timber has been cut to pass remedial legislation. With most of its original stand still intact, and with a progressive reforestation law, it is in an enviable position to make its forest industries permanently prosperous on a large scale. The author gives a brief and clear description of the main features of the Oregon law.

HISTORY was recently made in Oregon when 97,954 acres were classified for the growing of future forests in Clatsop County. This selection and listing of lands for reforestation is the first to be completed under the provisions of the Oregon reforestation law enacted by the 1929 legislative assembly. The success so far attained in the administration and actual application of this new measure indicates its practicability to meet one of the state's major problems.

The Oregon law was drafted after more than eight years of study and effort on the part of those interested in the future of the state's greatest industry. In the history of reforestation legislation, it has been the common custom for a state to wait until its timber resources become practically exhausted and then at one stroke to endeavor to effect a cure which should have received attention years before. The Oregon legislature is to be commended upon recognizing the fact that, even though this state yet contains more timber than any other in the Union, it is none too soon to provide means for perpetuating its greatest natural resource.

At present the lumber and associated industries employ 47,000 persons—65 per cent of the state's entire industrial payroll. It is easy to understand why the perpetuation of these forest resources and industries is of such vital importance to the prosperity of the state when it is known that 16 per cent of the taxes are derived from the timber and allied forest manufacturing plants and industries.

The problems of reforestation are many; for instance—taxation, fire protection, land classification, and the establishment of a new forest crop are all vital to the success of a statewide reforestation program. There are many others of lesser importance. As a result of the study made in Oregon to ascertain what specific steps were first necessary to aid in the reforestation problem, it was found that the taxation problem was of primary importance. Each year the area of cut-over land in this state is increasing at the rate of approximately 130,000 acres. Most of this land is rough, inaccessible, of poor soil quality, the bulk of it having little or no sale value—in other words, land capable of no higher use than for the production

of forest crops but most excellently adapted for this one particular purpose.

The tendency of dropping the obligation of ownership through tax delinquency has become acute, particularly in those counties in western Oregon where large areas of merchantable timber have been cut. Hand in hand with this tax delinquency problem goes that of fire protection. In other words, if the present system of statewide protection from fire was to be held intact, the low-valued lands must continue to bear their fair proportion of the fire protection costs. As the owners let their logged-off lands go tax delinquent, so did they cease paying for fire protection on them. These are particular reforestation problems that the Oregon law is primarily designed to correct. It is not intended as a panacea for all of our forest ills, but it does recognize clearly some fundamental issues to be faced and provides means for overcoming some of the principal obstacles.

Colonel W. B. Greeley, one of the nation's leading authorities on reforestation, has the following to say for the Oregon law: "The principle of a low fixed annual land tax supplemented by a yield tax on forest products ultimately harvested appears to be the best basis yet developed in a nation-wide study of forest taxation as at least the starting point in encouraging private ownership. The forestry law recently passed by the State of Oregon is an admirable expression of these principles, and, in my judgment, is the most promising legislation of this character yet adopted by any American commonwealth."

The purposes of the law are principally:

1. To promote reforestation on forest type lands not suitable for more profitable use.

2. To encourage owners to retain ownership of forest growing land for future forest crops.

3. To encourage natural reforestation on forest growing lands and hence through the creation of forest values to encourage the protection of these lands from forest fires as provided by state fire laws.

4. To provide a fair and stable annual forest fee on the land itself during the long period a forest crop is being grown and then a yield tax from the forest crop at the time it is harvested when the property is best able to pay.

This law does not require an owner to reforest his lands, but does encourage it indirectly. It helps make it good business for him to do so. However, planting in the main is not necessary to secure a new crop of timber, provided that adequate protection from fire is afforded. The law endeavors to give the owner a fair and stable tax status, thus encouraging him to retain title to the land. When he does so, fire protection must be afforded in compliance with the compulsory fire patrol law. When adequate fire protection is provided, cut-over lands will, in the main, reforest naturally.

The outstanding differences between the Oregon law and the forest tax laws of many other states are two. First, the fixing of a definite amount to be paid annually by the owner on his reforestation lands, and, second, the method of reforestation-land classification. Several other states, in endeavoring to stabilize the annual taxes on lands devoted

to new timber production, have provided for a fixed valuation placed on the land itself. This method is helpful to the owner but still leaves him the uncertainty of his annual reforestation tax bill because of the variation each year in the amount of the local tax levies. Oregon's law definitely stabilizes this annual carrying charge by providing for a forest fee of five cents an acre. This annual payment by the owner provides current revenue for local and state government and gives him the assurance of a defiinte annual carrying charge. Immediately upon classification, the public obtains a 12½ per cent equity in all forest crops then on the land or grown thereon during the period of classification. Whenever the owner harvests his forest crop he pays a tax of 12½ per cent of the gross value of the crop harvested. The only variation in the total amount he pays the public will be due to the variation in the value of the crop which the land produces.

The other feature of the Oregon law which is different from other similar laws lies in the method of providing for the classification of the land devoted to reforestation. This law is unique in that the classification is not made upon application of the land owner but is based entirely upon the character and use of the land itself and is made by a state agency. This provision is a wise one because it permits speedy and uniform reforestation classification essential for a successful statewide program. Where the reforestation classification is made optional, the acreage classified depends entirely upon the interest and action of the owners in listing their lands under the law. Experience has proven that classification under this plan is only fairly satisfactory. The responsibility for classification is placed upon the State Board of Forestry with review by the State Tax Commission.

Upon the selection of lands to be classified, a hearing is held in the county in which the lands are situated, at which time the owners are given an opportunity to present arguments for or against the proposed classification. After the hearing, the list is revised and sent to the State Tax Commission with a complete report of the public hearing. The commission issues the final order governing the classification of the lands and notifies each owner and the county assessor of the official classification. The following March the classified lands are extended on a separate county tax roll and are given their new tax status.

In addition to the annual forest fee of five cents per acre and the yield tax of 12½ per cent, the lands are subject to the annual cost of fire protection the same as they were prior to classification. Lands so classified are not subject to the ad valorem property tax or special road or school levies. However, values other than forest crop values, such as improvements, mineral deposits, water and power rights, and values of similar nature may still be taxed under the ad valorem tax laws of the state.

No forest crop may be harvested without a permit from the Board which states the unit value of the crop to be removed. This unit value is fixed by the Board. During harvesting the owner is required to keep records of the amount of the forest crop harvested and to re-

port semi-annually to the county treasurer on the quantity removed and the amount of the yield tax then due. The state is well protected, as safeguards have been provided to insure the receipt of the yield tax. Not only are bonds required in certain instances but a 10 per cent penalty attaches through failure to make reports and remittances within the time specified by law. In addition, failure to secure a permit to harvest forest crops or the making of false returns constitutes a misdemeanor and is punishable by either fine or imprisonment or both.

As before stated, this law is not designed as a cureall for the entire reforestation problem. The impossibility and impracticability of even endeavoring to draft ideal reforestation legislation at one stroke is recognized. A complete and practical legislative program can only be built up by degrees. As the law is applied, actual application will be the true index to the soundness of its provisions. It will not be difficult to gauge its measure of success because this will be directly reflected in the acreage of cut-over land retained in private ownership and the continued responsibility afforded for fire protection.

Oregon has made an excellent start on the most vital part of its reforestation problem, and from progress so far made the law appears fundamentally sound and thoroughly practical.

NORWEGIAN LAWS CONCERNING PROTECTION FORESTS AND THE PREVENTION OF FOREST DESTRUCTION

By OTTO NIEUWEJAAR

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Norway guards her protection forests with great care. Legislation affecting the handling of such forests has been in effect for nearly forty years. Frequent revision has been necessary to fit the laws to needs and to overcome local objections. What a private owner can do on his own land is rigidly circumscribed by law. A study of the author's recitation of the circumstances leading to the present law indicates that forest legislation is not a simple matter.

In recent years the problem of how to prevent forest destruction in general and the destruction of protection forests in particular has received a great deal of attention in this country, and the chief arguments pro and con are well-known to professional foresters. The problem has long been the subject of discussion and of legislative action in several European countries, such as Norway, Sweden, Switzerland, France, and the Balkan states, and these countries have attempted to solve the problem through legislative measures along the following lines:

1. The state takes over the forests and handles them entirely from the standpoint of public benefit.
2. More or less strict forest preservation laws are enacted, the land being retained in private ownership and the owner restricted in his right of disposal.
3. All cuttings are made dependent upon marking by public authorities.
4. Reforestation is made mandatory within a limited period of time as fixed by public authority.

In Norway the problem of protection forests has long caused great anxiety, due to the unfavorable natural conditions of the country, with its high northern latitude, steep mountain slopes, and high altitudes. It is known that the timber line has declined steadily during the last few centuries and that it is still doing so, due to overcutting and perhaps even more to overgrazing, and also that conifers are, for the same reason, being supplanted by hardwoods.

It has been estimated by the officials of the recently made national forest survey that in three of the best timber producing fylkes (counties), Opland, Buskerud, and Telemark, protection forests comprised, respectively, 30.7, 22.4, and 17.8 per cent of the total forest area. In Nordland fylke, in the northern part of the country, the percentage was 54.9. The question of protection forests is therefore of great national importance to Norway.

The first Norwegian law concerning protection forests was passed on June 20, 1893, but was later superseded by the law of August 8, 1908, which, with a few supplementary changes, is still in force.

The law of 1908 concerning the maintenance of protection forests and the prevention of forest destruction, author-

izes the herred (township) councils to establish either:

1. Protection forest by-laws, which are to be valid either for the entire forest area located within the herred or for certain parts of it, or

2. General forest by-laws, to be valid for all forests within the herred and to contain general provisions concerning the cutting and handling of either coniferous or deciduous forests or of certain species therein.

The law of 1893 allowed the township councils to prohibit grazing in a forest before June 24 of any given year. When the protection forest law was to be changed in 1908, it was proposed to limit grazing in a forest to the period between June 24 and November 1, as experience had shown that if grazing were allowed outside of that period the live-stock, particularly sheep and goats, would feed on the tops and twigs of young trees. But due to the fear that a limitation on grazing might be greatly to the disadvantage of the sheep raising interests in western Norway, the Storting did not incorporate in the 1908 bill any clause intended to regulate grazing on forests.

The law of 1893 stipulated that forest by-laws should not apply to forests which were managed by graduate foresters on rational principles approved by the Department of Agriculture. But this clause was left out of the law of 1908, and thus the forests scientifically managed by professionally trained foresters were subject to interference by less well-trained forest rangers. Naturally such conditions were unsatisfactory, and it gradually became the practice not to interfere with the management of private forests under professional supervision.

High timber prices during the war caused a heavy cutting of small trees and in order to check their overcutting, the supplementary law of June 7, 1916 fixed the cutting limit for all forests which were not subject to marking by the public officials at 20 centimeters (7.88 inches) at 1.5 meter (4.92 feet) from the top of the highest root. These provisions were to apply only to those herreds which did not have forest by-laws at that time.

Obstacles to the success of these laws were found in the fact that the Department of Agriculture was not given authority to determine the provisions of the herred by-laws, and also that the department had no way in which it might control the observance of the provisions of the laws. A supplementary law was therefore enacted on June 8, 1928, in which the chief control over the observance of the by-laws was vested in the state and fylke forest officials, in which the King, in case a herred council refuses to pass satisfactory by-laws, is authorized to enact by-laws, first asking the advice of the herred council and of the fylke forestry association.

Naturally, the general forest by-laws do not always satisfactorily prevent the overcutting of protection forests. The fylke council, on the suggestion of the Department of Agriculture, may decide that it is necessary to pass special protection forest by-laws, the limits of these protection forests to be fixed by three men having forestry knowledge and appointed by the herred council. The text of the by-laws is proposed by a professional forester appointed by the department for that purpose. The herred

council thereupon decides as to the forest boundaries and the text of the by-law and it is then subject to approval by the King.

The whole system is, then, based upon the self-determination of the herreds. The effectiveness of the law has been greatly obstructed by the fact that the majority of the herreds and sometimes the whole fylke have been hostile to the introduction of protection forest by-laws. The responsible authorities have therefore realized that the law should be revised. Consequently, the Department of Agriculture has recently submitted a new bill (Odelstings Proposition nr. 16 av 27. Februar, 1930) proposing a full revision of the old law. The chief provisions of the proposed law are as follows:

Protection forests are forests located outside of enclosed fields and necessary for protection against avalanches, landslides, washouts, or sand drifts, and also for the protection of other forests or of cultivated land. They also include forests located in such high altitudes or in such close proximity to the ocean or so far towards the north as to retard their growth to an extent making them easily destroyed if overcut or otherwise handled incorrectly.

The question as to whether all forests of a herred or only specially designated areas are to be classed as protection forests is to be determined by the department in charge of forest administration (Department of Agriculture). An expert in forestry under special appointment of the Department of Agriculture proposes certain areas to be classed as protection forests. He is to be assisted by a forest board, of which mention will be made later, or if there is no forest board, by two persons, chosen by and among the herred council who are familiar with forest conditions within the herred. The proposal is to be submitted to the department and is thereupon to be sent to the herred council together with the comments of the department, if any. It is then to be made public by the herred council, and four weeks after publication it is to be returned for final decision to the department, together with any comments received from the public.

The handling of the protection forests is to be subject to special rules with the object in mind to insure their future preservation and reproduction, and the fylke foresters or the state forest supervisors are to have the main control of them. These officials are to be assisted in their work by a forest board, consisting of five members, of which at least three shall be owners of forest property and shall be chosen by the herred council. The parish councils may also appoint a similar board for each parish. The duty of the boards is to see that the by-laws are enforced. If the by-laws provide for the appointment of a herred forest board, this board is to have charge of the forests, and in such case there is to be appointed no special board. The immediate supervision is to be under special forest rangers, whose wages are to be paid partly by the herred and partly by the state. The state may also appoint special rangers and markers for the protection forests.

No cuttings may take place in a protection forest unless the timber is marked by the rangers or by special markers. The owner of the forest and

an owner of real estate who is in the possession of an easement to cut timber on the forest may cut what is required for his household purposes upon marking by the ranger, provided the forest will not be damaged by the removal of the wood. The owner has the right to demand that all timber which might be cut for sale without damaging the remaining stand or the future reproduction shall be marked at once, provided such a cut does not necessitate expensive measures for the reproduction of the forest. Permission to cut for sale or for industrial production cannot be given to such an extent that it would cause a shortage on the property in question of the quantity of wood usually required for household purposes in that locality. The forest owner or the person holding the right to cut is obliged to utilize all dead timber and refuse which might serve the purpose in hand before any green timber may be cut. But refuse, stumps, and entirely dead trees may be cut without interference by this rule, and windfalls may be used for household purposes. Poisoning or girdling of trees are prohibited and the forest board may also forbid the lopping of branches and the peeling of bark on other trees than those which are intended to be cut that year. Hardwoods are to be so felled as to leave a clear, smooth stump and this stump is not to be more than 10 centimeters high above the top of the highest root. The cutting of branches and of foliage (used for feeding sheep) may be made only upon permission or marking by the ranger.

Requests for marking are to be submitted before April 1 and the marking is to be done before October 1. Birch trees are to be cut between September 15 and April 1, unless special permission is obtained to cut at some other time. If extra help is required for the marking of the trees, the owner or the holder of the use right is required to defray its cost. The cutting is to be done according to instructions prepared by the ranger.

Any cutting contrary to the law or to the instructions is to be punished by fines, unless the person liable is willing to reforest within a definite period of time and under the ranger's instructions. The decisions of the ranger may be appealed to the forest board or to the department.

If the owner agrees to reforest his land, but, upon inspection it appears that he has not done so within the allotted time, he is required to pay whatever the work would have cost and the board is to take the necessary steps to have the work done without the assistance of the owner. The owner may appeal the determination of the cost to the department.

The county forestry association or the state forest supervisor may decide that ditching and reforestation is necessary in a protection forest. The owner of the forest cannot protest against such work if it is to be done without causing more of an expenditure to the owner than what has already been reserved for reforestation purposes at the time of past cuttings of timber for sale, manufacture, or export. Such reserved amount is provided for in the by-laws established by the herred or parish councils, but shall not exceed 1.00 krone for every 100 pieces of timber or .10 krone for every cubic meter of felled and lopped but otherwise unmanufac-

tured wood. The amount is to be deposited in an authorized savings bank on an account bearing the name of the owner. He is then entitled to a refund from the account with accrued interest for the cost of any work undertaken by him in order to secure reproduction on the property. When it appears that no work of that kind will be required in the near future, the owner may demand that the balance of the account be repaid to him. The fylke forester or a person appointed by the fylke governor decides as to whether the refund shall or shall not be made.

The existing by-laws dealing with the preservation of protection forests are to be repealed and the communal authorities are to prepare new by-laws to prevent forest destruction. These by-laws are to be valid for all forests in the district except enclosed land, and are to contain general provisions dealing with the felling and handling of coniferous or deciduous forests or of the various species thereof, excepting those trees growing within enclosed fields. The by-laws are to be approved by the King, but before they are to be submitted for his approval they are to be laid open for public inspection for a minimum period of four weeks.

Norway has now had forest by-laws in force for more than a third of a century, and it may therefore be of value to add a few words concerning their effect.

When the law was originally introduced protests were often heard that it was unethical to encroach upon the right of a private owner to handle his forest as he found most advantageous. But these protests have gradually ceased to be heard since it has been generally realized in Norway that the interest of the public should have preference over the interest of the individual in the handling and preservation of forests, even to such an extent as to prevent the owner who may be pressed for funds to cut his forest in a manner contrary to good silvicultural practice.

There is no doubt that the provision permitting the herred councils to decide as to whether by-laws should or should not be enacted, and if so, as to the tenor of those laws, produced uneven effects. Sometimes the diameter limits were placed so low as to render the effect negligible. The owner might have decided to cut the forest down to the lowest diameter limit, which, under certain conditions, might not be far from razing, and if the law did not stipulate that the marking was to be made by the ranger, the public would be unable to prevent such razing.

If marking was provided for in the laws it was necessary to have a competent staff of rangers in whom the forest owner had full confidence. Given a competent staff of rangers, there is no doubt that the effect of the law was beneficial to the forest, since it stimulated interest in rational forestry practice among the smaller owners and provided them an opportunity to obtain capable advice as to the best method of handling their forests. Also, a great number of the larger forest owners have employed professional foresters to manage their forests in order to be more independent of the public control. This they would not have done if it were not for the by-laws. The direct effect has been that a great deal of young trees have been spared, particularly where the diameter limit was high.

A WORD FOR EXOTICS

By E. W. GEMMER

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Exotic tree species have been used in this and other countries many years with varied success. When failure occurs it may be due to the selection of the wrong variety rather than to the species itself. Experience with exotics to date is not conclusive proof that they have no place in American forestry. The author believes that exotics, especially their possibilities on poor sites, deserve intensive study.

DURING the past few years, the attention of foresters often has been called to the desirability and the possibilities of forest tree selection and breeding. (1, 12, 3, 5, 6, 9, 13, 15.) In almost every case the objects to be attained are: rapidity of growth, immunity to disease or insect attack, and the production of specialized products. The attainment of these qualities would be a boon to foresters and forestry. However, the problems involved are not simple; plant genetics involving forest trees is only now getting a start, with most of the fundamentals as yet to be determined (13). While we are waiting for investigators to make known these essentials, and bridge the gap of time necessary to produce supertrees, what shall be done with our deforested acres? Assuming that they should be producing some tree growth, should we favor average native stock or should we count on exotics?

Exotics, particularly conifers, have generally acquired a bad name as a result of poor growth and low quality productiveness, not only in America but also in Europe (14). Foresters have been prone to sow any and all exotic seed available. Is it, then, so remarkable that the results have been almost uniformly failures? This, however, has not always been the case. Here and there, excellent stands of timber have resulted from planting an exotic, while there are a few instances, such as the introduction of *Pinus radiata* into New Zealand, and of *Pinus patula* into South Africa, where the results have been extraordinary (7, 8, 15, 10). Two-thirds of present-day Denmark's forests "consist of evergreens planted by man—wholly artificial forests" (16).

We are beginning to recognize that the cause of many failures has not been due so much to selection of the wrong species, but rather of the wrong variety. Variations within species are often sufficiently pronounced so that they can be segregated. We now recognize several varieties of Scotch pine, maritime, Norway, and western yellow pine, to name but a few of the better-known (10). The tardy recognition of variations within a species is sufficient evidence that to condemn that species upon the results of haphazard planting in the past is not justified. Considering the wide range of climatic conditions and soils to be found throughout the forests of the world, it seems reasonable to assume that somewhere else on the globe conditions approach those with which we are work-

ing. The assumption can also be made that in comparable regions, nature has developed distinct species or varieties, any one of which might be substituted for the other, possibly to the advantage of the tree and the forester. The assumption that native stock marks the highest possible development for that area may not always be entirely justified. Again, foresters are not limited to tree production of climax stands, and as modifying agents can utilize plants unknown to the original stand.

The problem of finding a tree or trees particularly adapted to a given site becomes increasingly difficult as the site becomes poorer. Good sites seldom require the heartbreaking efforts to reforest that are called for on poor sites. Tree-breeders are interested primarily in growing forests on good sites under intensive methods. It is doubtful whether such species would show the hardiness necessary to be useful on adverse sites. Bates (4) found that varieties of western yellow pine from localities near the Nebraska National Forest have shown the best survival at the Bessey plantations. Scotch pine, Austrian pine and jack pine have also given satisfactory results. He objects to the possibility of ultimate success of these species on the theoretical grounds that there is no instance of commercial success with exotics under unfavorable conditions of climate and soil. On the Nebraska Forest, it remains for an extreme climatic test to demonstrate the truth in this instance. Studies by Graham and Baumhafer (11) have shown, for the same Nebraska Forest, that western yellow pine is the most susceptible to injury by tipmoth, whereas Norway, Jack, Scotch, and Austrian pines are less susceptible, in the order named. Apparently, here is a case where the species best adapted climatically may be limited by other factors, making it worth while to try less perfectly adapted species.

The problem on the Choctawhatchee National Forest, in western Florida, is equally complex. On this forest, there is a residual stand of short-boled, flat-topped, longleaf pine. Because of frequent fires, infrequency of seeding, adverse climate, and poor soil, among other factors, this forest is not reproducing itself satisfactorily. If artificial reforestation proves necessary, should longleaf be favored and should native seed be selected for sowing? Development of longleaf on this adverse site is extremely slow, the seedlings requiring 20 years to reach breast height, and average diameter growth in older trees takes place at the rate of 1 inch in ten years. The chief value of this longleaf pine is for naval stores production, the financial possibilities of which, on this poor site, are rather dubious. The present culled nature of the forest would suggest that seed other than native-grown may be used.

What has any exotic to offer in comparison to the native longleaf? Any species puts on fairly rapid height growth at least in the early stages, and could not possibly be any slower than the present longleaf. If resin production is essential, there are a number of other species available for trial which would produce yields comparable to those obtained from longleaf pine. Seed of known source and quality could be used, and the resulting trees would probably produce seed at an early date in

quantities which would insure the possibility of natural reproduction in the future. In addition, there is the added chance of discovering a species which could mix silviculturally and economically with the native longleaf to produce heavier stands, of better products. For instance, a non-resinous species could be utilized for pulpwood, leaving an ideal stand of longleaf for the turpentine orchard. It would seem that the introduction of exotics offers the best possibility for improving conditions on this forest. Similar conditions are to be found on extensive areas in the South, and the same kind of problem arises at many points throughout the country.

On the whole, it would seem wise to enlarge upon the studies of the possibilities of exotic trees in the United States. Tree breeding, while helpful, may not completely solve the problem; time and production are also important. Poor sites in particular demand immediate attention, and exotics of known aptitude should be given thorough trials.

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DISTRIBUTION OF FOREST PLANTING STOCK IN PENNSYLVANIA[1]

By E. F. BROUSE

District Forester, Pennsylvania Department of Forests and Waters

The public distribution of planting stock has reached large proportions in several states. Many of the plants are not put to the intended purposes and many plantations are failures. The author analyzes some of the failures and suggests important changes in regulations controlling distribution, especially the minimum number allowed each applicant. Success, the author finds, is more likely in large than in small plantations.

THE planting of forest tree seedlings on State Forest land started in Pennsylvania a few years after the first purchase of land was made in 1898. By 1910 more than two million trees had been planted and since that time there has been a gradual increase of forest tree plantations on the State Forests. At first there was little organized effort toward, or popular demand for the planting of forest tree seedlings on the part of indivdiuals or corporations, but as there were several million acres of privately owned forest land within the State in need of reforestation, it was evident the planting would have to be done by the owners, if at all.

Among the earlier private plantings were those of the Girard Water Company in Luzerne County in 1877 and the plantations made by the Pennsylvania Railroad in 1902, the latter "as object lessons to farmers." The Spring Brook Water Company began some extensive planting operations in 1906 on their lands located in Luzerne County near the City of Wilkes-Barre.

The Department having established a reforestation program on State Forest land, soon recognized the need of aiding the private forest land owner, with the result that in 1909 the following Act was passed by the Legislature and approved by the Governor:

"That the Department of Forestry is hereby authorized to grow and distribute to all persons who will plant and care for them, young forest trees in such quantity and under such conditions and regulations as may be prescribed by the Department. The Department of Forestry shall make a reasonable charge for such trees not in excess of the actual cost of production. Those who make application for such trees must enter into an agreement with the Department to bear the cost of transportation from the various State nurseries to the place where ordered to be sent and that the young trees will be planted under the direction of the Department of Forestry and cared for and protected."

The first trees distributed under this Act were planted in 1910, when 66,375 trees were sent out from the State Forest nurseries. The rate of distribution was comparatively slow, and during the first six years only about 400,000 trees were distributed. It was believed that reforestation projects on private lands should move forward more rapidly, and

[1] Presented at Foresters' Conference, Mont Alto, Pa., January 29-30, 1930.

in 1915 several changes were written into the law, the most important of which was that the trees were to be distributed free, with a minimum shipment of 500, and a charge of 10 cents per thousand for packing. This new procedure stimulated tree planting to the extent that there were 1,472,000 planted in 1916 by private planters, or twelve times the number planted in 1915. In 1917 a charge of 20 cents to 40 cents a thousand was made for boxing and packing, with a minimum of 100 of one species and 500 in a shipment. In 1920 the charge for boxing and packing was increased to 50 cents per thousand, and the minimum shipment reduced to 100. In 1925 the boxing and packing charges were increased to $1.50 and in this year a rule was adopted which definitely restricted the use of trees to forest planting. They were not to be used for shade, ornamentation, hedges, or Christmas trees. In 1927 the minimum shipment was increased to 500 and a law was enacted which provided for a charge not to exceed the cost of production. The production cost was placed at $2.00 per thousand for seedlings and $5.00 per thousand for transplants. The same law was in effect in 1928 and 1929 except that the minimum number was increased to 1,000.

Regardless of the minor changes, the different methods of distribution all embodied the idea that the trees were to be used primarily for reforestation and watershed protection. Some of the changes, especially those of 1915 and 1920, were made to stimulate the planting of a larger number of trees, and in this were successful. The changes of 1927 and 1928 which embodied an increase in the minimum number and provided for planting site examination, planting assistance, and follow-up work were made primarily to insure, so far as possible, an increase in the percentage of successful plantations. While it is somewhat early to judge what the re-results will be, it is believed that this plan is accomplishing the desired purpose.

Under the different plans more than 83,000,000 forest trees have been distributed by the Department to private individuals and corporations in all parts of the State. From time to time a few examinations of scattered plantations were made at the request of the planters, but the true condition of private plantings in general was not known. However, the Department eventually recognized the need of determining the success of private plantations, and in 1925 under the direction of the Bureau of Research and Information the first organized survey was made of approximately 200 plantations in nine counties of the State. It was my privilege to take part in this survey and a summary of the observations was submitted to the Foresters' Conference at Mont Alto in that year.

Additional examinations were made in 1926 and 1927, and in 1928 a survey was made of 961 plantations in all sections of the State, embracing a total of 6,792,000 trees. This again disclosed a large number of failures and the reasons therefor. It is my opinion that the size of the plantation, within certain limits, is an important factor in its success or failure. The assumption is that the persons who plant the larger numbers will carefully handle and plant the trees as well as make an effort to protect and care for them as the years pass.

With the size in mind, some statistics were prepared and Table 1 summarizes the results from the examination of plantations during the years 1925 to 1929 inclusive:

This record comprises 2,346 private forest tree plantations with a total of 12.25 million trees planted in 41 counties of the State. It indicates that by number of plantations only 43.1 per cent are successful, but on the basis of the number of trees planted they are 66.9 per cent successful because the larger plantations had the better survivals. In plantations with 2,000 trees or more there are more successes than failures. The reasons ascribed for the high percentage of failures are careless handling, poor planting, underplanting, pasturing, ornamental planting, fire, insects, and improper selection of species.

According to past results, we may expect that with the present minimum distribution of 1,000 trees, 58.4 per cent of the plantations will have an establishment of 65 per cent and over, and with a minimum distribution of 2,000 trees, an establishment of 64.8 per cent might be expected.

During the year 1929, 34 per cent of the 300 planters in the Valley Forge District planted the minimum number of 1,000 trees, and 21 per cent additional planted less than 2,000 each. In other words, about 50 per cent of the planters set out 180,000 trees and the other 50 per cent set out 1,010,000 trees. It is believed that a twentieth of the larger shipments and probably half of the minimum shipments to the private planters during 1929 were not planted primarily for timber production or watershed protection. It is questionable whether the planting of 1,000 trees spaced 5 by 5 feet and covering little more than half an acre is an honest effort toward reforestation. If our applications for small numbers of trees could be reduced one-half and some of the small planted areas be eliminated, thereby causing a theoretical reduction of 15 per cent to 18 per cent, it would be justifiable. The actual reduction in the total number of trees planted undoubtedly would be less than 10 per cent.

The increase in the minimum shipment of 1,000 trees helped immensely to remedy certain unsatisfactory conditions which resulted from the distribution of small numbers of trees, and which very frequently found a wide variety of uses other than for reforesta-

TABLE 1

PRIVATE FOREST TREE PLANTATIONS EXAMINED IN PENNSYLVANIA DURING THE YEARS 1925-1929

Number of trees per Plantation	Number of plantations		Percentage of plantations 65% survival or over	Total number of trees planted	
	Survival 65% or over	Survival under 65%		Survival 65% or over	Survival under 65%
100-500	109	477	18.6	34,666	151,054
501-1000	115	295	28.0	109,925	258,100
1001-2000	161	220	42.2	275,625	332,350
2001-5000	268	189	58.6	950,550	681,000
5001-10,000	165	88	65.2	1,206,650	697,700
Over 10,000	195	64	75.3	5,682,700	1,924,200

tion purposes. It is therefore quite evident that a further increase would prove of value in the establishment of successful plantations. The beneficial results can be shown to a certain degree by the reports on the plantation examinations in the Valley Forge Forest District during 1929. The summary is given in Table 2.

The average number of trees in all the plantations examined is approximately 5,600, whereas those established during the past 2 years and examined average approximately 10,000 trees. Private plantings as a whole average 3,600 for the years 1928 and 1929 which will account in part for the larger number of successful plantations during the past several years. Too much significance cannot yet be attached to these results because the plantations are young, and fire, insects, and rodents have had little time or opportunity to kill or injure the planted trees. However, experience inestablished the battle is nearly won.

This increase in the number of successful plantations cannot be attributed to any one factor. During the past several years the Department of Forests and Waters has shown more interest in private plantings. Examinations have been made of planting sites, much planting assistance has been given and the follow-up work is being reflected in the results obtained.

This work should be extended, for until the proper supervision is exercised we cannot expect good results, and past experience has proven that merely distributing the trees has not been satisfactory. The private planting and care of forest trees occupies an important place in Pennsylvania's forestry program, and the inspection of the planting

TABLE 2

RELATION OF SUCCESS TO NUMBER OF TREES PLANTED

Year of Establishment	Number of plantations examined	Number of successful plantations[1]	Average number of trees originally planted in successful plantations	Average number of trees originally in plantations considered failures
1911	1	—	—	500
1915	1	—	—	1,000
1916	7	4	16,000	2,600
1917	8	5	8,600	1,300
1918	12	4	8,000	1,600
1919	9	4	7,500	1,600
1920	11	5	6,600	1,000
1921	16	9	4,100	2,200
1922	29	10	11,000	2,600
1923	34	10	12,600	1,000
1924	45	20	6,600	1,500
1925	46	23	6,300	950
1926	57	25	6,800	2,400
1927	67	40	7,200	3,500
1928	40	37	9,400	13,600
1929	35	32	10,800	6,300
Totals	418	228	8,700[2]	2,700[2]

[1] Over 65 per cent establishment considered successful.
[2] Average size of plantation.

site, instruction in planting methods, and periodical examinations, are essential.

From time to time the idea has been advanced that it might be well to make a charge for the trees approximating that of the commercial nurseries, and not in any way restrict their uses. This might lighten the Department's obligation to a certain extent, but I am of the opinion that it would be a blight on reforestation. The present charge is a vast improvement over the system of free distribution, however.

In order to discourage the planting of trees on land which may be developed before the trees grow into timber, especially adjacent to cities, it might be well to include in the agreement a stipulation that trees should not be planted on land assessed at more than $75 or $100 per acre. When trees are planted on land of high value it is safe to assume that reforestation is not the primary object, no matter whether 1,000 or 10,000 trees are planted.

It is my opinion that the present plan of forest tree distribution by the Pennsylvania Department of Forests and Waters is fairly satisfactory. If an increase from 1,000 to 2,000 trees in the minimum order were put into effect, there is no question that a higher percentage of successful plantations would be secured. Technical supervision could be more readily accomplished and by reason of close contact with tree planters better results could be expected.

TEN YEARS' FORESTRY EXTENSION WORK IN PENNSYLVANIA

By C. R. ANDERSON

Extension Forester, Pennsylvania State College

Forest extension work is comparatively new and may be said to be still feeling its way. Extension foresters are pioneers in a new field. From the description of the work here described it is evident that the extension forester may be a tremendously important agency for better forest management.

THE Smith-Lever Act, the basic act providing for agricultural extension service, was passed in 1914. Forestry was first placed definitely on the extension program through the initiation of specialist service on July 1, 1919, when the writer was asked to devote one-fourth time to assisting county agents, at the same time continuing with much of the resident teaching which he had been doing as a member of the faculty of the Department of Forestry of the Pennsylvania State College.

Prior to the date indicated, some work had been done by the Department of Forestry under an arrangement whereby the farmer paid all expenses connected with the service except the salary of the worker. This work was largely that of assisting the landowner on timber-estimating and on plans for marketing his timber.

At the time of Pennsylvania's appearance upon the scene, the only states doing forestry extension work were Maryland, New York and North Carolina. There were others in which the work had been started, but all except those mentioned had dropped the work temporarily, to resume operations later.

In Pennsylvania, the early months of extension work were occupied largely with "selling" forestry to the county agents of the State. This in itself was no small task. The county-agent program was still very new in many of the counties. In some cases the agents themselves did not yet know just what they could do for their people, and the latter had not yet begun to sense fully the assistance which they might receive from this new "aid to agriculture."

As fast as the extension forester could get an opportunity with a particular county agent, a visit was paid him, they would talk about forestry, look at representative parts of the county; and would then plan something definite to do. Viewed in the light of later days, there was much "wandering around" at times. There was then no extension forester within the agricultural extension organization at Washington. We had, however, the able assistance of W. R. Mattoon of the Forest Service.

Early Days in Extension Work

The first piece of extension work done by the new extension forester of Pennsylvania was on October 27, 1919, at which time a conference was called in the office of Roy M. Decker, County Agent at Stroudsburg, Monroe County, to consider work which might be attempted within that county.

The first field meeting was held April 29, 1920, at a farm in the Poconos of Monroe County. The attendance was fair—four adults and the youngsters from a nearby school. This was intended to be the first permanent planting demonstration area. The trees caught well, but the farm tenant, not in sympathy with the forest planting idea at all, pastured the plantation despite the cautioning against it. So many of the trees were pulled up, eaten, or trampled by the stock, principally horses, that the area was abandoned at the end of the first year and a new and better coöperator sought.

The work grew slowly but surely. By April 1, 1921, interest had reached a point which demanded more time than any person could give it and at the same time teach at the College. At this time the writer went on a full-time basis. Two and a half years later Frank T. Murphey came into the organization, since which date the work has engaged the full-time activities of two men.

In 1920 the records show that work was done in eight counties; last year work was done in all the counties having county agents with the exception of four, in three of which, however, demonstration meetings had been held at one time or another prior to last year.

Forestry work in many of the states received encouragement with the passage of the Clark-McNary Law, Section 5 of which provides that a sum of money, not to exceed $100,000 in all in any one year, may be devoted to extension work in forestry. The states receiving money at the present time under this arrangement get $1500 per year each. There is also some money provided for extension work under the Capper-Ketchan Law, but none of this was ear-marked for forestry, although in some states it has benefitted somewhat through the operation of this rather new law.

The Program of Work

Extension is not limited to any one way of doing its work. It aims to take its teachings out to the home, the garden, the field, the barn, and the woodlot to induce the owner on his own ground to try the new practice to the end that he may adopt it. Newspapers, exhibits, tours, radio talks, movies, lantern slides, circular letters, demonstrations showing methods of doing a thing, demonstrations showing results, bulletins, essay and other contests, advertising, telephone, talks, farmers short courses, organized classes, and other means are used. These vary in use and efficiency, depending upon a variety of things. Some of the ways and means which may be employed are given in some detail in the article appearing in the December, 1929, Journal of Forestry, entitled "Better Woodlands for Berks." Commonly more than one means of reaching people is selected.

Forest Tree Planting

Early in his experience in this new field tree planting demonstrations seemed to be worth while for three reasons: First, that there seemed to be altogether too many plantations securely hidden in the hills and too few along the well-travelled highways.

Second, there seemed to be too much careless handling of young trees and that those persons who received them

for planting needed to be shown how to take care of them to get results. The excellent paper summarizing findings of several District Foresters of Pennsylvania on the examination of a large number of plantations presented to the Allegheny Section of the Society a year ago by Charles R. Meek, gives evidence upon this point that the choice was not unwise.

Third and not so apperent at the time, was that for one reason or another planting seems to offer an easy way of approach to get people interested in forestry. It must be that the great contrast between the bare hillside and the timber crop of tender years take hold more powerfully upon farm people than does other forest work. Forest planting appears to be a good entering wedge.

Many details of results would weary you, but some figures must be quoted. To the end of the 10-year period, the county agents held almost six hundred planting meetings on demonstration areas. More than 80 per cent of these were held during the planting seasons and the average attendance was 17 persons. May we quote briefly from our last annual report?

"At the present time, distributed throughout the state, there are a total of 350 (permanent demonstration) areas. . . . . All except two counties in the state have at one time or another had tree-planting demonstrations given in them. Sixty-one of the 65 organized (extension work) counties have one or more permanent planting demonstration areas."

Our planting work is practically statewide. Thousands of farms have been visited by the county agents, with or without the specialists, in the interest of the planting work.

Improvement-Cutting Work

The beginning of the improvement-cutting program followed close upon the heels of the planting work. The first real thinning demonstration made November 9, 1920, in Monroe County, was a failure as to attendance. Only the owner was present.

It was more difficult to get people interested in improvement cutting than in the planting and the project developed slowly. The records show that the county agents held 24 field meetings in the year 1924, and a total of 108 last year. Altogether there have been nearly 400 such held in the state, with a total attendance of 3200 people. It has proved much more difficult to find well-located permanent demonstration areas than in the case of the planting work. Approximately 20 per cent of the areas on which meetings have been held are of such a character.

The work is not anywhere near as state-wide as in the case of the planting. One or more field meetings have been held in each of approximately 40 counties. The ultimate aim of the Extension Service is to apply the method described in the December, 1929, Journal under the title "Better Woodlands for Berks" to a large number of the counties. At the end of the 10-year period the method had been applied in seven counties. During the last year there were not less than 700 woodland owners in these seven counties who were thinning under the program. The project calls for intensive work for three years. New counties will be added as these drop out.

There are now a half-dozen or more counties fully ready, in our judgment, for the application of this intensive method of reaching their people on this project.

Timber-Estimating and Marketing

Meetings held to extend information on timber-estimating and marketing are always interesting. The lack of knowledge on the part of timber-owners as to what they have in their woodlots is almost appalling. So far, we have held a field meeting at every point where requested. One year the number went to 21; the total number held to December 1 of last year was 80; the average attendance was 9 persons; and the timber owned by those present lay somewhere between 60 and 80 million board feet with a value somewhere near $700,000.

The first meeting of this character was held in Erie County in July, 1920. We have speculated more than once on the value of such a meeting to a group of farmers. One man has reported that what he learned at one such meeting enabled him to get $1500 more for a certain lot of timber. It is difficult to evaluate the work in terms of money—and we are not sure that we should—but it is worth at least five per cent of the value of the timber represented at the meeting. Viewed on this basis, the county agents who have held such meetings have rendered a return of $35,000 from this item alone.

Early in our work, we prepared a project for the development of coöperative timber marketing, but the "youngster" failed to survive.

We have done almost no timber-treatment work except to answer individual requests. We believe our farmers are not ready for it, and in some counties we are in doubt whether it ever will be a seriously needed project.

The maple syrup and sugar work is developing. We have found that our makers can equal the best Vermont product, and that steam-coil evaporation, practiced by a number of our best makers, deserves more consideration than it has received from those who are installing new equipment. Increasing interest is being shown in local exhibits of maple products and in that of the annual State Show at Harrisburg.

Sawmill and Manufacturing

This is our "baby" project, developed and handled by Murphey. His account of the work, as written in our report for 1929, deserves quoting:

"This branch of extension teaching is still new. It appears to be of great importance to the woodland owners for there seems to be a tremendous lack of knowledge in preparing timber for the market. During the year four sawmill demonstrations were given at which methods of manufacturing, grading, seasoning, and preparing the timber for the market, was shown. All of these meetings were well attended by very interested men.

"Five crosscut saw filing demonstrations were given. Without an exception these meetings were particularly appreciated by the farmers attending. Not a single saw brought to the demonstrations had been fitted and sharpened as it should have been. Some of the saws used by farmers in cutting their timber were in such shape as to make sawing a real burden. A short period during some of the thinning demonstrations was given over to instruction in fitting crosscut saws.

"The work for the year follows:

Sawmill demonstrations	4
Crosscut saw filing demonstrations	5
Total attendance	113
Counties in which demonstrations were held	4"

There are still other activities which should be mentioned but the time is too brief. The total of indoor meetings on forestry held by the county agents runs into the hundreds, and the attendance into the thousands.

The white pine weevil work is of interest. It is handled by the Extension Entomologists of the College under the direction of H. E. Hodgkiss. Practically all the plantations, containing white pine which are on our list of permanent demonstration areas, and which are old enough for the weevil to develop, are followed up from year to year. Hodgkiss is quite convinced that the barrel-trap method for holding the weevil in check and for increasing the parasites is well worth the extra time and labor it costs the farmer.

At the end of the 10-year period the white pine blister rust work had just been started by Extension Pathologist R. S. Kirby. His reports for the calendar year 1929 show a number of meetings held with a gratifying interest in this problem.

Two circulars were prepared during the 10-year period, for publication by the College, and both have now been printed.

Our publicity man at the School of Agriculture of the College reports that during the last five years approximately 200 separate forestry articles of one kind or another have been prepared by the extension foresters for him, or written by him from information they furnished him. These have gone to county agents, daily newspapers, weekly newspapers, farm papers, and monthly magazines in a few cases, and altogether have proved a tremendous influence for forestry in Pennsylvania.

IMPRESSIONS OF EUROPEAN FORESTRY

By R. R. FENSKA

New York State College of Forestry

Recently returned from a tour of European forest regions, the author writes of his observations. He reports that silvicultural methods are profoundly affected by local economic conditions and that systems of pure stands, once considered best and widely copied in this country, have proven to be injurious to forest soils. He also found that cheap timber imported from America and other countries, makes the cutting of some forests unprofitable.

THE forests of Europe offer a most interesting field study for the American forester; especially the teacher of forestry. Silviculture and forest management as practiced in Europe cannot, of course, be applied directly to any of the forest areas in our own country. Economic conditions are entirely different in each country. Yet to see how intensively a forest *can* be managed when the economic conditions permit it, is an inspiration and gives a forester greater respect for and interest in his own profession.

Germany, I believe, has the most scientifically and intensively managed forests in the world. Some think the Germans have gone into the matter of forest management with much greater detail than is necessary, and they say, for instance, that a country like Sweden handles its forests in a more practical manner. However, when an American forester sees some of the forests of southern Sweden he is reminded very much of the forests of his own country, and immediately gets the impression that they are being over-cut. The Swedish foresters, however, claim they are not cutting quite their annual growth. No doubt the forests of Sweden are as efficiently managed as the soil, climate and economic conditions permit. The Germans, however, claim that the smallest detail must be scientically worked out to get the greatest possible returns from their forest soil. In each country the degree of intensity to which silviculture and forest management are applied depends on local and economic conditions.

The coming timber famine about which we heard so much years ago, is still more than a century away. At least that is the impression one gains when traveling through European forests and notices the surplus stock of growing timber for which there is at present not a sufficient demand to tempt the forest owners to cut it. They claim our high-grade Douglas Fir from Washington and Oregon and the hardwoods from Poland and Russia have brought down the price of timber in Europe to the point where their local product cannot at present compete with the foreign imports. This, of course, does not apply to the lower grades of lumber. Another surprise, during the author's recent visit in Europe, came in the statement of several foresters that the hardwood forests of central Europe are no longer a paying proposition. This is interesting in view of the fact that it was the apparent threat-

ening scarcity of available firewood in Europe a hundred years ago or so that gave the practice of forestry its great impetus. With no local coal available and poor transportation facilities, the people quite naturally looked to the beech and oak forests for their supply of fuel wood. Now these very same forests are no longer desirable from an economic viewpoint. Some fine beech and oak forests can still be seen in Europe, but they have a special or local value, such as supplying an isolated community with its fuel wood or as part of the national defense. Only the softwoods are really in demand.

The chief softwood species of Europe are Norway spruce (*Picea excelsa*), Silver fir (*Abies pectinata*) and Scotch pine (*Pinus sylvestris*). Among the hardwoods, beech (*Fagus sylvatica*) is the most abundant, with oak (*Quercus penduncuIata*) next, followed by a scattering of maple (*Acer pseudoplatanus*), birch (*Betula pendula*), ash (*Fraxinus excelsior*) and linden (*Tilia europea*).

In the pineries some form of clear cutting followed by planting is used, because of the intolerance of the Scotch pine. In the other forests everything from pure stands of spruce, fir or beech, to a mixture of these with pine and oak, can be found. Pure stands of fir have proven a failure and pure stands of spruce are not desirable. Pure stands of beech, however, can be grown very satisfactorily. The reason that stands of pure spruce or fir are no longer favored is because of their effect on the forest soil. Spruce and fir alone do not produce enough ground litter to keep the soil of the proper texture and there is also a tendency for the soil to become sour or acid. These conditions greatly reduce tree growth. The remedy lies in bringing in about 10 per cent of some tolerant hardwood species, preferably beech. In the eastern United States this would not be a difficult task, but in Europe many a forester has not slept nights trying to determine some practical way to accomplish this apparently simple task. All European foresters give a great deal of thought to the factors influencing their forest soil conditions. A mixture of the three softwoods together with beech seems to give the best results. In these mixed forests all, except pine, are tolerant species and hence natural regeneration is very successful with any form of shelterwood cuttings. As the stand is gradually opened up, the fir and beech come in first, followed by the spruce. When the final cut is made, the Scotch pine fills in the open spaces.

Of the different shelterwood systems in use, Wagner's border cutting "*Blendersaum-schlag*,"[1] the Baden wedge system "*Keilschirm-schlag*,"[2] and the group shelterwood system "*Schirm-schlag*" all give excellent results as far as natural regeneration is concerned. Only in rare cases is it necessary to resort to planting.

The two factors that any method of cutting must carefully consider are windthrow and damage to young growth during logging. To successfully overcome both is the final test of any system where natural regeneration is used. In some parts of Germany (Black Forest) the individual stand or forest is the unit and

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[1]Silvcultural Systems, R. S. Troup, pp. 88-101.
[2]*Op. cit.*, pp. 105-108.

basis of forest management rather than the more or less arbitrary compartment.

In Switzerland there is a tendency to return to the selection forest. The Swiss claim it is the best system for their topography, soil, and species.

In France are some fine examples of beech and oak forests where the system of coppice with standards is used to regenerate the area. The chief revenue is from fuel wood—the lowest form of forest product and hence small financial returns.

During logging operations all softwoods, after they are felled, are immediately peeled in the forests to avoid attack by wood borers. The bole is seldom cut into log lengths before it is sold. All skidding is with horses and must be so carried on as to avoid any damage to young growth. The size and character of a logging operation in Europe precludes the use of any such machinery as is usually found in logging operations in this country.

The European fir brings practically the same price on the market as the spruce. The Scotch pine in some localities is not of the best form, but in other regions it compares very favorably with our own Red pine in quality. The beech is chiefly a fuel wood tree in Europe and its size and form are of secondary importance.

One lesson we may well learn from Europe is in the matter of tree seed selection. In Europe tree seed dealers furnish a statement with every pound of seed, showing its source as well as a germination test from a reliable seed testing station. The seed testing station in Copenhagen, Denmark, maintained by the State, where both forest and agricultural seed may be sent for testing, is a model of its kind.

All over Europe one can find experimental plantations of exotic trees and practically every American tree species has been tried out. Most of them have proven a failure or not desirable. Only a few will find a place in their system of forest management. The most notable success has been with our Douglas fir. They like this tree very much because it produces a straight, clean bole, good strong timber, has no serious insect or fungus enemies, a thick bark which resists ground fires, and the seedlings can be easily grown in the nursery. In the city forest of Heidelberg, Germany, is as fine a 50-year old stand of Douglas fir as can be found anywhere. Our white pine over there has been severely hit by blister rust and is no longer being planted. Specimens of the Balkan white pine (*Pinus peuce*) have so far been immune from blister rust and more experiments will be carried on with this species. The wood is similar to that of our own Eastern white pine and growth is fairly rapid. Abies concolor and lodgepole pine from the western United States also promise much, judging from the specimens found in arboretums. Of other exotics, the Japanese larch (*Larix japonica*) has done very well in Europe. As a general rule, however, the native trees are favored over the exotics.

In one of the large pure spruce forests in Germany an attempt was made during the war to "tap" the trees for resin. The experiment proved unprofitable even under such an urgent demand for naval stores as existed at that time.

No organized forest fire protective system was found in all Europe. The

public is extremely careful with fire when in the forests. When a fire does occur, coöperation is received from every available citizen.

One outstanding factor in all European forests is the excellent and permanent system of roads. This makes possible a high degree of forest utilization. Germany, a densely populated country, nevertheless has one-quarter of its land areas under forest cover. Most of it is in some form of public ownership. In many communities any important new public building or highway is financed entirely with funds from the sale of timber from the communal forest.

In Germany all forests, whether public or private, are open to the public for recreation.

Summary

A system of silviculture and forest management must be developed for each particular region (or country) and species.

Economic conditions at present make a pure hardwood forest in Europe an unprofitable financial venture.

Except in the pineries, the mixed forest of softwoods with 10 per cent beech or oak and natural regeneration is the favored system of forest management. The hardwood leaf litter is necessary to maintain proper soil conditions for tree growth.

A knowledge of the source of the seed is of great importance in selecting stock for reforestation. A standard germination test is also made of all seed.

All the important exotic timber trees of the temperate zone have been tried out in central Europe with only partial success. The most promising are Douglas fir, Balkan white pine, Concolor fir, lodgepole pine and Japanese larch. Our Eastern white pine is no longer planted on account of the blister rust.

Tapping spruce trees for resin has not been found profitable.

An excellent road system throughout all European forests makes for a high degree of utilization of the forest and its products.

REVIEWS

Dictionary of Biological Equivalents. By Ernst Artschwager, *Williams and Wilkins Company, Baltimore, Md. Pp. 239, illustrated. 1930. $4.50.*

Foresters will find this new lexicon an invaluable aid in accurately translating German biological literature into English. This work, broad in scope, gives in concise and precise form the English equivalents of 15,000 German terms relating to forestry, entomology, zoölogy, and the other branches of biological science. Terms used in chemistry, geology, psychology, electricity and mechanics, are also included. A list of common German abbreviations is given, with a list of the irregular verbs, and equivalent units of weights and measures. The gender of German nouns is indicated in each case in the text. The illustrations consist of six plates showing numerous morphological structures of leaves, flowers, fruits and embryo, birds, worms and arthropods, with the German-English definitions. Dr. Artschwager demonstrates in this work the ability and painstaking care which mark his many scientific achievements, and has given us a volume of great convenience and usefulness.

S. B. DETWILER,
In charge, Office of Blister Rust Control.

Plenterdurchforstung. (Selection Thinning.) By W. Schadelin. *Reprint from Zchweizerische Zeitshcrift für Forstwesen, 1927.*

In 1921 a description was presented in French of a "selection thinning" method which, although it was derived basically from Borggreve's method, is not to be confused with that fantastic and impracticable invention. The new plan, as devised by Dr. Biolley, is described and commended by Schadelin in the article being reviewed.

The principal features of this new method, as compared with Borggreve's and the French system of thinning, are as follows:

1. It takes out all oppressed trees which are likely to interfere with the starting and development of natural reproduction. In this characteristic it resembles Borggreve's method and differs distinctly from French thinning, which disturbs only the upper layer of the forest.

2. In the top stratum of the stand, it removes only those trees which by their position offer serious competition to the surrounding dominants or are of lower quality, poorer form, or slower rate of growth than the neighboring trees. Their removal is intended also to open up the crown cover sufficiently to furnish light for the development of natural reproduction below. In this respect the method differs from Borggreve's in that the

trees removed are not necessarily dominants, but rather have the character of those taken out in an improvement cutting. It is unlike French thinning, on the other hand, in that the trees removed are not limited to those codominants which are competing with the trees making up the ultimate stand.

3. The final object of selection thinning is to convert a stand into the ideal type of continuously producing selection forest ("continuous" forest), with a normal distribution of age-classes. In contrast, Borggreve's method and French thinning tend to produce even-aged stands for clear cutting.

4. When a stand has been converted into a selection forest, the thinning is continued with the new object of permanently maintaining the stand at the point of highest productivity.

In marking, trees may be selected in the same operation for thinning and for the crop. Each tree should be marked with a threefold object: the maintenance of high productivity, the retention of the selection form of forest, and the removal of a crop. This combination of purposes makes selection thinning an operation of unusual difficulty.

The author concludes with a suggestion as to cutting practice. The marked trees of the upper stratum should be felled and removed first so that in the event of damage to the understory the marking of the oppressed trees may be revised. If the small trees are removed first, subsequent damage through the felling of larger trees may seriously affect the forest cover.

Selection thining in its new conception might, at least in a conservative application, prove very practicable in this country for the conversion of unbalanced stands into ideal selection forests with an even distribution of age-classes.

Harold G. Wilm,
Cornell University.

A Thermoelectric Radiometer for Silvical Research. By Paul Raymond Gast. *Harvard Forest Bulletin No. 14. 1930.*

Foresters have long been aware of the importance of "light," solar radiation, in the growth of the forest. Gast's paper gives a brief historical review pointing out the need for a reliable method of measuring radiation in silvical work, and takes up the requirements such a method should fulfill. This section is perhaps a bit technical for the average reader, however most of the requirements laid down for a silvical radiometer are well taken. In the third section he discusses briefly the various means by which radiation may be measured. He stresses the fact that all methods which depend upon the illuminating, chemical, and electrical effects of light are not uniformly sensitive to the various wave lengths, while methods utilizing the heating effect of sunlight are non-selective in sensitivity. The effects of various wave lengths or colors of light on photosynthesis, and the growth of plants, are only partially understood at present, and as Gast points out, there is no reason for supposing that any selective instrument now available responds in the same way to radiation as the green plant, hence until more

information is available, non-selective radiometers are preferable.

Two types of radiometers are described, the massive base type, and the spherical hot junction type. Due to the lag, slowness of reaction and zero shift, the massive base type was abandoned, but is described because it was used to obtain records given later. The spherical type consists of a thermopile with five pairs of junctions. The hot ones are nickel-silver spherical beads. The sensitive element is mounted in an electric lamp form which is evacuated and sealed. The thermopiles are of convenient size and easy to set up in the field. Figures for lag and zero shift are not given. Gast was only partially successful in building a radiometer which would be independent of the direction of sunlight. It is hard to see how any instrument other than a perfectly uniform black sphere could be. The thermopiles are connected with a recording microammeter for getting continuous records.

The records of the radiation received in the open, and under 40 and 85 per cent canopies, while subject to certain errors, are very interesting in showing the tremendous daily variations. Hourly records would have shown still greater variations. His conclusion that 40 days' continuous records are necessary to get a reliable estimate of the radiation under a canopy is a bit discouraging to most investigators.

In his final section he correlates the growth in height of white pine with the radiation received in the three stations. The figures show increasing growth with increasing sunlight in almost direct proportion. Since no records of other factors was kept, this direct dependence of growth upon light cannot be completely accepted since moisture, soil and air temperature, and soil nitrogen supply were probably all more favorable in the open.

The bulletin contains an appendix in which some of the physical principles are elaborated.

The reviewer finds the paper interesting and believes it represents a valuable step forward towards more precise methods in silvical investigation. So far as is known this is the first set of light intensity measurements which have been carried out in the forest with thermopiles and recording apparatus. The radiometer itself can only prove its value through careful laboratory tests and extensive field use. No other light-measuring device except the radio-atmometer of Livingston has spherical receptors so far as the reviewer is aware.

The author tends to give a one-sided impression of the importance of radiation to the plant in considering only its effect on photosynthesis and nitrogen metabolism. His attempt to defend his work against those who emphasize root competition is only partially convincing.

The reviewer believes that much important work has been accomplished by the use of selective radiometers, of radiometers with flat receptive surfaces, and with discontinuous observations. While non-selective radiometers are highly desirable the case is not so clear for spherical receptors and continuous records.

It is felt that the paper would have been more valuable had it included a discussion of some of the more recent papers on the rôle of radiation in plant growth, and if a discussion of some of

the other non-selective radiometers had been given.

The average reader will find the field measurements interesting but is likely to get lost in the more technical parts.

HARDY L. SHIRLEY.

Forest Research in Switzerland. Vol. XV, 1929, Annals of the Federal Forest Research Station. Review by A. Poskin and N. I. Crahay. *Bulletin de la Societè Centrale Forestiere de Belgique. Vol. 36, No. 3, 1929.*

This report of the Swiss experiment station, Director M. le professeur H. Badoux, contains the results of three studies: 1. "The Soil and the Forest," by E. Hess; 2. "Forests, Soil Properties, and High Water," by Hans Burger; 3. "The Culture of Weymouth Pine," by H. Badoux.

THE SOIL AND THE FOREST

M. Poskin selects from the first study the following features which he evidently deems to be of most interest to Belgian foresters.

The author discusses the theory of hydrogen iron concentration in the soil, as an edaphic factor of great importance in modern soil science. The acidity or alkalinity of the soil is expressed in figures according to the following scale:

pH	Nature of Soil
4	Strongly acid
5	Acid
6	Slightly acid
7	Neutral
8	Slightly alkaline
9	Alkaline
10	Strongly alkaline

The factors which have a great influence on soil acidity and therefore on soil quality are:

1. Climate, especially humidity and rainfall. When the moisture supplied to the soil is greater than the evaporation from it the soluble alkalins are carried from the upper to the lower soil levels, resulting in an acid condition at the surface. When evaporation is greater than precipitation the alkalins solutions rise by capillarity from the lower to the upper levels and the surface pH becomes neutral or slightly alkaline.

The pH of soils varies, in Switzerland from 4.0 to 7.8, in Sweden from 4.0 to 8.4, in Denmark from 4.6 to 8.4, etc.

2. Vegetation also exerts an influence on soil acidity, indirectly by the formation of humus. Some vegetative associations may modify the properties of the soil until finally a new and stable state is reached. Vegetative species re spond differently to variations in the soil pH. Amann & Braun-Blanquet have adopted the following classification which appears better than the old distinction between calcoreous and sandy species:

a. Acidiphiles, which exist on soils with a pH of 6.7 to 4.0. b. Neutrophiles, which exist on soils with a pH of 7.0 to 6.7. c. Basiphiles, which exist on soils with a pH of 7.5 to 7.0. d. Indifferents, which exist on soils with nearly any pH.

Most of the forest species are acidi-

philes; there being only a few broad-leaved species such as beech, oak and basswood which are neutrophiles. According to Franck, in Germany, the ability to withstand acidity diminishes in the following order: pine, spruce, white fir, beech, larch. This author also considers soils of pH 4.4 to 7.4 as favorable to forest vegetation.

Hesselman has studied the influence of various species on the soil according to the chemical composition of recently fallen leaves. On this basis he has delineated the following groups:

a. Much acid material and little alkaline: all the resinous species except larch.

b. Little acid and some alkaline: nearly all the broad leaves except the oaks and maples.

c. Very little acid and considerable alkaline: the hazel and the elms.

d. Much acid and much alkaline: the oaks and larches.

It is therefore evident that pine stands of resinous species, larch excepted, increase soil acidity. To counterbalance this influence it is desirable to introduce broad-leaved species. According to Hesselman the best species for such introduction are: hazel, elm, birch, alder, aspen, willow, beech, ash, maple, oak. Hess also stresses the fact that hazel is especially desirable because of its abundant detritus which is rich in calcareous material.

3. Cultural operations thus affect soil pH values according to the species purposefully planted or reproduced. Hess cites the case in which the introduction of oak under-planted in pure pine raised the pH from 3.6 to 4.7 even though oak is recognized as only moderate in its ameliorating effects. Furthermore, as a very dense canopy favors the formation of humic acid, thinnings may be made to reduce such tendencies. The density of canopy and the methods of silviculture will vary according to altitude, precipitation, exposure, and subsoil in attempting to influence soil pH values.

The last section of the report by M. Hess is devoted to the natural reproduction of spruce, the effects of depth of duff layer, its acidity, how to hasten decomposition and improve chemical condition, etc. The use of fire to reduce the duff layer and expose the mineral soil is recommended.

Forests, Soil Properties and High Water

From the second report mentioned above, M. Poskin points out the fact that the Swiss research concerning the influence of forests on streamflow is widely known and appreciated. Two methods have been employed: the first consists of measurements and comparisons of the amount of water which falls on the soil and that which runs off the surface; the second, a study of the soil and its water.

After studying the physical properties of many types of soils, some covered with forest and some bare or in pasture, M. Burger draws the following conclusions. Reforestation modified pasture soils very advantageously. It rendered them more mellow, more permeable, and capable of holding a larger proportion of the rainfall, while an important fraction of this water ran off the surface of pasture lands. But for

many years the influence of the forest was shown only in the upper soil layers. This superficial influence was especially noticeable for stands of pure spruce. Larch and most of the hardwoods had a more pronounced effect. Spruce had only a restraining effect on the permeability of the soil. In dense stands and in a humid climate pure spruce often results in an acid condition which provokes rapid disintegration of the soil and consequently a diminution of the influence of forests on stream flow. The forest acts beneficially on stream flow only under certain conditions which appear to be also the most natural state and cycle of development and that in which the permanent production of material is at a maximum.

The Culture of White Pine

The third study in the Swiss publication, "The Culture of Weymouth (White) Pine," is reviewed by N. I. Crahay, who adds several comments from the point of view of the Belgian forester. *Pinus strobus* was first introduced into England, from America, by Lord Weymouth in the year 1705, then gradually into all European countries. The blister rust is rated as its principal enemy, although there is quite a long list of fungi and insects which also attack it. The growth is so good, however, and the quality of the wood so fine that both M. Badoux and M. Crahay strongly recommend its continued culture.

The Swiss report dwells by chapters upon the distribution of this species in Switzerland, the experimental plots being used to study the species, its height and volume growth—42 metres at 110 years, its demands upon and accommodations to different soils, the climate that is most favorable, the characteristics, uses, and prices of the wood, and the enemies of the species. Badoux emphasizes the importance of cleanings and thinnings, while Crahay stresses the value of mixture of species, especially the production of a dense understory of either hardwoods or conifers as one defense against the blister rust. Crahay calls attention to the control of Scotch pine rust by the use of Bordeaux mixture and anticipates the development of a similarly successful treatment for the white pine blister rust.

H. T. Gisborne,

Northern Rocky Mountain Experiment Station.

Second-growth White Pine in Wisconsin: Its Growth, Yield and Commercial Possibilities. By S. R. Gevorkiantz and Raphael Zon, *Univ. of Wis. Agr. Expr. Sta. Res. Bul. No. 98: 1-40, Fig. 1-10. 1930.*

How long does it take white pine to become merchantable and what are the possible yields and money returns that may be expected when it has been grown? The answer to these and other questions was the object of a growth study of white pine in Wisconsin.

This bulletin is essentially a yield table for white pine. Financial yield tables, volume and stand tables are also included. The methods of analyzing the data and the methods of applying the yield, volume and stand tables are dis-

cussed in the appendix. Yields are given for very poor, medium, and good and excellent site quality classes. These classes are equivalent to 45, 50, 60, 70 and 75-foot 50-year site index classes. For the poor, medium and good sites, figures are given for stands from 30 to 120 years old and for the very poor and excellent sites for stands from 30 to 60 years old. As these two site classes are based only on three plots and one plot respectively, the question whether these figures should be presented might be raised. In the appendix, the yield tables are again presented, merely changing their form. In view of the high cost of printing tables, the reviewer cannot see the object of this. This space might have been devoted to tables giving the average d. b. h. and average number of trees for the yields in board feet.

The mean annual growth of total cubic volume without bark of all trees one inch and over culminates at 70 years. This is true for all sites as a result of using the anamorphic method. At this age, fully-stocked stands on medium sites produce on an average 8,470 cubic feet per acre at the rate of 121 cubic feet per year. In the same time poor sites produce 6300 cubic feet per acre, or one ninety-foot cord per acre per year. On good sites, 10,570 cubic feet are produced at a mean annual rate of 151 cubic feet per acre. On medium sites, 447 trees averaging 10.1 inches in diameter at breast height and 77 feet high; on poor sites 605 trees averaging 8.2 inches in diameter and 64 feet high; on good sites 386 trees averaging 11.2 inches in diameter and 91 feet high produce these yields.

The peak of lumber production in fully-stocked stands is reached on poor sites at 100 years, medium sites 90 years, and good sites at 80 years when the trees 7 inches and over in diameter are scaled to a 5 inch top by the International (one-eighth inch) log rule. Assuming an average rotation of 80 years, poor sites produce 36,500, medium sites 59,000, and good sites 77,000 board feet per acre. These yields are equivalent to a yearly average rate of production of 456, 738 and 962 board feet per acre.

The yield table is based on very carefully selected sample plots laid out in stands in the northern half of the state. Of the 130 plots measured, only 92 were utilized. After such a careful selection in the field, the advisability of such a heavy rejection in the office might be questioned. This heavy rejection was due in part to a new method of throwing out abnormal plots. In addition to the standard method of rejection, a method based on the following premise was used: "in full-stocked stands having a certain average diameter there must be a corresponding average number of trees in the stand." This relationship is shown by a curve showing number of trees over average stand d. b. h. An attempt to define normal stocking with such mathematical rigidity may well be questioned, especially when dealing with Mother Nature. This curve does, however, as the authors point out, provide a very simple and practical means of determining the degree of normality in the field when applying the tables.

The financial yield tables give the cost of growing a thousand board feet of lumber. The total cost is given for an 80-year old stand on poor, medium and good sites for planting costs ranging

from $4 to $11 and compound interest rates from 3 to 5 per cent. Costs were assumed as follows: land $1 an acre, annual expenses such as protection costs, etc., 5 cents per acre, taxes 10 cents per acre, a severance tax of 10 per cent of the gross yield. Stumpage is assumed to be $15 per thousand board feet. Yields per acre by the Scribner Decimal Log Rule from the yield table were used as gross yields. This table is the basis of the following conclusions drawn by the authors: "The growing of white pine under the provisions of the forest crop law will earn five per cent on the original investment and annual carrying charges and still leave an additional profit on the better soils, particularly if the cost of the land and planting does not exceed $12 to $13 per acre."

The bulletin is written in a very simple style. Technical definitions are explained in detail. It is therefore very readable, especially by the layman. As a research bulletin, however, it often goes too much into detail. If it were meant primarily as a technical bulletin, it could have been greatly reduced in length.

Until the appearance of this bulletin, a reliable yield table, based on site index classes and compiled by modern methods has not been available for white pine in the Lake States. For this reason, it is a timely contribution.

R. M. Brown,
University of Minnesota.

Forest Research in Pennsylvania. By Joseph S. Illick. *Commonwealth of Penn. Dept. of Forests and Waters. Pp. 1-17. 1930.*

In this bulletin, State Forester Illick gives a description of forest research in Pennsylvania with particular reference to the program and activities of the new Forest Research Institute. The subject matter was first presented as an address by the author at the official opening of the Forest Research Institute on June 5, 1930.

The Pennsylvania Forest Research Institute was inaugurated through the recommendation of the State Forester. Previously, forest research activities of the Department of Forests and Waters were carried out by the Office of Research, one of the subdivisions of the Department which was established in 1920. Ten years of experience in carrying on research work in close connection with general administration had demonstrated the desirability for a wider separation of the two activities and for this reason the Forest Research Institute was created.

The new organization is located at Mont Alto, one of the oldest State Forests in the United States, as well as being one of the best developed and well managed forests in the country. The Institute occupies a portion of the buildings formerly used by the Pennsylvania State Forest School before the transfer of the upper class work to Pennsylvania State College. The staff consists of a Director and six foresters, at the present time. Plans call for the employment of an entomologist, specialists (on a part-time basis, as needed) and research fellows. The Institute is one division of the Department of Forests and Wa-

ters. It is not connected in any way with any forest school, although opportunities will be available at the Institute for graduate work through arrangement with coöperating colleges and universities.

A broad program of forest research is set up for the Institute. It is the announced policy to attempt to solve first those problems which are of most pressing importance and which at the same time give the greatest promise of an early solution. The author does not, however, hold out any promises of any miraculous results on a short time basis for he points out specifically the danger in regarding research institutions as "witchcraft shops" and research workers as magicians. He believes forest research to be "a normal and necessary undertaking promoted for the purpose of improving forest practices, that will reflect itself in improved forest conditions."

To other Eastern foresters and timberland owners who have long since regarded the chestnut as a lost species, concentrating on salvage and replacement, it will be interesting to note that research work at Mont Alto during the past three years has brought out the possibilities of the recovery of this species. The results of the study have been published under the title of "The Recovery of the Chestnut." Studies are also under way in the natural replacement of chestnut and a report on this phase of the problem will be prepared shortly.

One of the most perplexing of Pennsylvania's reforestation problems lies in the increasing amount of damage to young planted stands from damage by deer. These animals have increased considerably in the state during recent years. There are recorded instances of plantations as large as fifty acres being entirely destroyed through deer cropping. This problem has already been studied to some extent, and a preliminary report on the observations made is in the stage of preparation. Work on this problem, most important on account of the large acreage planted annually in the State, will be continued to determine the most feasible means of control.

Pennsylvania is making sure of future tree seedlings of valued inherited qualities through the establishment of seed-supply stations in stands exhibiting the desired qualities of vigor, straightness and resistance to disease. Studies having to do with the quality of seed used in Pennsylvania's forest tree nurseries will be one of the major projects of the Institute.

Other projects to be undertaken by the Institute include: forest fire problems, white pine blister rust, the inferior tree problem, approved cutting methods, nursery and planting problems, natural reproduction, forest biology, forest types, growth and yield, forest soils, wood using industries, and a survey of forest resources.

Pennsylvania, acknowledged as a leader in state forestry work, has again taken the initiative in establishing the first research institution supported entirely by state appropriations. Those interested in forestry matters are indebted to Mr. Illick for his well written description of this new development in the state forestry field.

JOHN R. CURRY,
California Forest Experiment Station.

Investigations on the Infestations of *Peridermium complanatum*, Barclay, on the Needles, and of *Peridermium himalayense* n. sp., on the Stem of *Pinus longifolia*, Roxb. Part I. *Distribution, pathological study of the infections, and morphology of the parasites.* By K. D. Bagchee. *Indian Forest Records 14, 79-102, 13 pl. 1929.*

During the past few years, chir plantations in Kumaon became heavily infected with two rusts long known as *Peridermium complanatum* var acicola and *Peridermium complanatum*, var. corticola.

It is shown that these supposedly two varieties of *P. complanatum* represent two distinct species, one of which, *Peridermium complanatum*, causes a relatively non-important leaf infection, the other, *Peridermium himalayense*, causes an important—often fatal—stem infection.

The morphological characteristics of the two fungi and the pathological changes caused by them are described in great detail. The article is illustrated with 12 plates, and a bibliography of 20 titles is appended.

Henry Schmitz,
University of Minnesota.

Experiments to Determine the Influence of the Time of Felling on the Properties of Wood of Norway Spruce and Silver Fir. By Herman Knuchel. *Supplement to the Journal of the Swiss Forestry Society, No. 5, Part 1. Buchler & Co. Bern. 1930.*

The proper time of felling trees and the influence this has upon the properties of wood such as durability, strength, fuel value, resistance to shrinking and checking has always been of interest to wood users. In Europe the best time for felling is considered to be in late fall and winter, and little or no felling is carried out from January to early summer. Winter-felled wood is specified in the contracts covering the wood intended for use in buildings and in the wood-using industries.

Past investigations have shown no differences in the wood at different felling times but the change in the properties of wood may be traced to the conditions to which wood is exposed *after* felling.

Forest management has specified certain restrictions affecting the time when felling takes place in the forest. Winter has become the most popular time in the lowlands of Switzerland because at that time only is there sufficient experienced labor available. Summer felling is preferred in the high snow-covered mountains because:

1. The stems can be easily barked and thus prevent insect attack.

2. The wood dries quickly and can therefore be utilized sooner and is lighter to transport.

3. The wood is of a lighter color.

The drawbacks to summer felling are the formation of shrinkage cracks and the introduction of fungous infection.

The author carried out experiments on fir and spruce which grew in a 120-

year old stand of spruce-fir-beech mixture. Samples from the test trees were tested for strength of both green and air-seasoned material. The rate of drying as well as the shrinkage was studied and the swelling was recorded after immersion in water. Tests to determine the chemical composition of the wood samples as well as their fuel value were also conducted. Durability tests (the relative resistance to decay), were left for a future study.

As far as seasonal felling was concerned the studies show no variations in moisture content, shrinkage, swelling, chemical composition, or fuel value of the test material. Such variations as were observed were easily traced back to the effect the handling and storage of the wood underwent after felling. At the end of the summer following each cutting the maximum shrinkage difference was found after 15 months in the spring-cut wood, after 12 months in the summer-cut wood, after 9 months in the fall-cut wood and 4 to 6 months in the winter-cut wood. In spite of the great difference in moisture content in the green condition of fir, very little difference in shrinkage between the heartwood and sapwood was noted. In spruce the difference is evident; the shrinkage in volume for the sapwood being 3.6 per cent and for the heartwood 2.6 per cent.

The specimens cut from trees felled from October to January dried very slowly taking 6 to 8 months to reach a constant air-dry weight, while those cut from May to July took but 1 to 2 months. The slow drying of the winter-cut wood was observed to continue even in the warmer months following the felling. Differences in quality of the wood may result from the differences in rate of seasoning.

Taking into consideration the conditions prevailing in practice, the author concludes that neither summer nor winter is the best time for felling but recommends the period from September to the end of November. The rapid seasoning with its attendant reduction in shipping weight and the protection it affords against the attacks of insects and fungi accounts for this choice of felling periods. The author also emphasizes the fact that the quality of the finished wood product depends greatly upon the care which wood is given after the tree is felled. Many of wood's best qualities are deplorably altered by unnecessary exposure to the elements and to the agencies which attack it.

E. E. Hubert,
University of Idaho.

Uber das Tannensterben (Concerning the Dying of Fir). By R. Schubert. *Allgemeine Forst und Jagd Zeitung. Vol. 106. Pp. 21. August, 1930.*

In many parts of Germany the silver fir is dying or dead from the effect of some disease, insect attack or from physiological causes. Professor Bernhard is quoted as stating at a meeting in 1924, "With reference to Saxony, I regret to say that fir is no longer a dying species, it is in fact practically all dead." The condition is more favorable elsewhere and in some regions fir stands are entirely healthy. The author cites a reference indicating that the

trouble was observed as long ago as the middle of last century. And yet, the cause has not been definitely determined!

According to Schubert, those foresters who have reached a definite conclusion as to the cause are divided into two groups. Group 1 fixes the blame on the fir twig scale (*Dreyfusia nuesslinia*) and possibly also the fir bark scale (*Dreyfusia piceae*). The forestry department of Baden has begun active control measures against the twig scale in the young fir stands under their control.

Group 2, to which the author belongs, believes that beetles, twig scale, fungi, etc., which are found on the dying fir trees are of secondary importance and attributes the real difficulty to lack of lime in the soil. In the vicinity of certain industrial plants the precipitation of acid (sulphurous) fumes have contributed to this unfavorable soil condition. The following causes are given to explain the exhaustion of lime content in originally rich soils.

1. Utilization of wood products and coniferous foliage (straw).

2. Leaching.

3. Precipitation of acid fumes from factory smoke.

As to the lime requirements of different species, the results of an investigation are given, showing that the following number of kilograms of calcium oxide are taken from each hectare (2.47 acres) of soil on the average each year for the given species and rotations and with average yields:

Species	(a) By Annual Wood Production	(b) By Foilage Production	Total
Red beech			
120 year rotation	22.25	81.92	104.17
White fir			
90 year rotation	4.12	79.64	83.76
Spruce			
100 year rotation	10.24	60.94	71.18
Pine			
80 year rotation	7.68	18.87	26.55

The above shows that fir ranks next to beech in its total lime requirements and while it uses less lime than the other species in the production of wood, this is held to be of far less significance than the amount found in the leaves where food is manufactured.

Having made this point the author next proceeds to a rough classification of the soils of Germany as to their productivity and derivation. The authority he cites divides soils into five groups as follows:

1. Very good (strong) soils
2. Good soils
3. Fairly good soils
4. Weak soils
5. Poor soils

The soils in the first two groups are derived from formations that are rich in available lime according to the classification of the underlying rock in the list.

What about the condition of silver fir on these rich lime soils? The author finds no evidence of the "Tannensterben" so common elsewhere and cites

examples to prove the point. In the management of the forests of Neckenhausen, a province having predominating lime soil, it has been decided to raise the percentage of fir from 50 per cent to 60 per cent in the mixed stands of fir, spruce, beech, and pine, this increase being made at the expense of the spruce which is not so well adapted to this soil. Obviously fir is thrifty in this region.

Instances are cited to show that some soils originally rich in lime have been depleted by the acid fumes from factories and that such soils no longer are suitable for fir and the species is dying or dead.

Finally Schubert points to the fact that in the Schwarzwald of Baden where the soil is deficient in lime, silver fir is dying in places where no trace of the twig scale has been found. He concludes that the primary cause of death generally is lack of lime and that the twig scale merely acts to hasten the finish. Research by soil experts is urged to determine the balance between lime requirements and lime supply, this being an important question not only in relation to fir but also for general forest culture.

C. F. Evans,
U. S. Forest Service, Asheville, N. C.

Holzarten auf Verschiedenen Boden-Arten. (Wood Types as Influenced by Soil Types.) By Burger Hans, *Mitteilungen der Schweizerischen Zentralanstalt für das Forstliche Versuchswesen, 16, 1:49-128 (1930).*

Those who are working with mineral constituents of trees and the assimilation of the different materials, will find interest in the results secured by Hans Burger.

The total weight of the ash was found to vary widely in the different tree species according to soil conditions. There was a distinct relationship between soils low in assimilable minerals and those rich in mineral constituents. There was a distinct trend towards high ash content in plants grown in soils rich in lime. Magnesia also was taken up by trees in a larger amount when grown in soil well supplied with this mineral. The ratio of lime to magnesia (CaO: MgO) varied with the different soils from 0.5 to 33.

The relationship between the content of phosphate—P_2O_5—of the soil and the plant was not brought out clearly in these studies, but showed a tendency of higher content in the plants grown in soils rich in lime and in P_2O_5 than in soils poor in lime, even where the phosphorus constituents were higher. These results are in accord with those procured from graminaceous vegetation by various workers.

The investigation shows no definite relationship between the potassium content of the soil and the plants. Seedlings grown on humus were invariably low in potassium. The low potassium content, however, did not appear to influence the growth rate.

The relationship of the iron content of the soil is not clearly reflected in the proportion of iron found in the plant. Likewise, there appeared to be no definite relationship between silica content of the soil and of the plants.

The least silica was found in roots and stems of so-called "silica loving plants," such as oak and chestnut. The relationship of $CaO:SiO_2$ in the stems of conifers was as 2 to 5. In deciduous trees the lime content was much smaller.

For the reason that muriate of potash was used as fertilizer, the nitrogen relationships were difficult to determine. On soils rich in lime, where the plants would use a large amount of this constituent, the percentage of nitrogen of the plants was smaller than on soils relatively poor in lime.

The study as a whole appears to show rather clearly that the proportion of the different mineral constituents is much influenced by the depth and spread of the feeding surface of the roots.

A. W. Sampson,
University of California.

The Formation of Spring and Summer Wood in Ash and Douglas Fir. By L. Chalk. *Oxford Forestry Memoirs 10. 48 p. illus. 1930.*

This contribution from the Imperial Forestry Institute, Oxford, deals with the seasonal growth and the factors which affect seasonal growth of Douglas fir and two species of ash. The trees studied grew in Bagley Wood near Oxford, England.

The first part of the memoir deals with the development of the ring during the growing season in ash and Douglas fir. Comparisons are made between the inception, duration and rate of growth of the same species growing in different environments, as well as between the growth of the trees of the different species. Literature on the subject of tree growth is cited and comparisons made between the results obtained by the author and those published by other investigators.

When first formed, the spring wood vessels in ash expanded rapidly parallel to the cambium; after which they enlarge radially. Full size was reached in from five to seven weeks. Tyloses had developed in the vessels of the last annual ring of those trees which had been wounded in removing the study specimens. It is known, however, that wounding of trees tends to stimulate tylosal formation.

The second part deals with the effect of climatic conditions on the growth of Douglas fir. It was found that the volume of both spring wood and summer wood varied from year to year. Moreover the fluctuations in the spring wood did not agree with those of the summer wood; therefore they are regarded as varying independently.

In most cases a negative correlation factor was obtained between the volume of spring wood and the climatic conditions prevailing during the time of its formation. A significant positive relation was found between spring wood volume and rainfall for the period of April, May and June. The general negative results may indicate that there are other factors affecting spring wood formation. The amount of stored food may be an important factor, and if so, a positive correlation may exist between spring wood formation and the climatic conditions obtaining during the period between the cessation of growth in the

late summer and the fall of leaves in the autumn. The correlation of summer wood with current climatic conditions, especially with rainfall, was generally positive. This may indicate that the formation of summer wood is dependent upon the climatic conditions of its period of formation.

The third part of the memoir deals with the effect of crown size on growth. It was found that during the interval of 1924 to 1927 the annual increment of the dominant tree increased steadily. In the intermediate trees, the annual growth remained almost constant and in the suppressed tree growth decreased. For six years previous to 1924, there was very little difference in the amount of growth in any of the four trees. This indicates that suppression did not occur prior to 1924. In all trees the maximum area of both spring wood and summer wood occurred near the base of the crown. Above and below this point, the area decreased. It is further shown that the decrease was least in the dominant tree and greatest in the suppressed tree. The specific gravity of the wood of the last four rings decreased from the butt of the tree upward to approximately the base of the crown, after which it increased. Table 9 indicates that the dry weight of the wood, especially in the suppressed trees, increased from the butt to the base of the crown. The statements appear to be contradictory and the author might have attempted to explain such unusual results. The variation in specific gravity, however, is in accordance with the general conception of its relation to ring width in the conifers.

The dry weight of the needles was adopted as the most reliable index of the relation between the wood produced in the main stem and the size of the crown. The dry weight of the year's growth was determined by multiplying the actual volume of the increment of wood for that year by the average specific gravity of the wood of the last four rings. Data are given to show that this method gives a close approximation of the dry weight of the wood. The efficiency of the needles is based on the amount of wood formed per unit of needles. It was found that the weight of the wood produced per gram of total needles varied between 1.5 and 2.5 grams.

A bibliography of 41 titles is of value to any one interested in tree growth.

L. W. Rees,
University of Minnesota.

Methods of Correlation Analysis. By Mordecai Ezekiel. *XIV, pp. 427, Fig. 75, John Wiley & Sons, New York, 1930.*

Are you interested in statistical methods, especially those methods that deal with relationships among variables? If so, Ezekiel's "Methods of Correlation of Analysis" will be of interest.

As the author states, the book is not intended to cover the entire field of statistics, but merely that phase that deals with the relationships among variables. This formidable subject is treated in a simple and clear style. The uninitiated and the non-mathematical forester will find it very readable compared with most books on statistics.

The subject is approached from the

art or how-to-do-it view-point rather than from the philosophical side or why it is done. Examples and graphs are used to explain each procedure. Foresters will be pleased and surprised to learn that the author shows a decided inclination to use that analytical tool (simple, freehand curving) with which they are familiar just as often as he does the more rigid mathematical procedures. One is also surprised to find, in this 1930 statistical book, the old cross-curving method to prepare volume tables, given as a method of attacking joint correlation poblems. It looks as though the pendulum were again swinging to simple graphic methods.

The method of presentation is from the simple to the complex. Beginning with the arithmetical average, deviation measures and measures of reliability, the author gradually leads to the methods of determining the linear or curvilinear relationships between but two variables. He then unravels the mysteries of the methods of multiple linear and curvilinear correlation or methods to determine the relationship of one dependent variable to two or more independent variables. Finally the methods of attacking joint correlation problems are presented. In each case methods of determining the degree of correlation between the variables and the accuracy of the derived estimating equation or chart are given. The methods of interpreting the results of each statistical analysis are fully discussed. These topics and many others are covered by this book. Those who are working with quantitative data will find the book very helpful.

R. M. Brown,
University of Minnesota.

Form Class Volume Tables. Department of the Interior, Canada, *Forest Service, Ottawa, Canada. Pp. 200. 1930.*

It has been the opinion of this reviewer that the development of form-class volume tables in America has not received the attention that the subject deserves, but the arrival of this handy little volume goes a considerable way towards refuting that idea. Form class volume tables for seven eastern and one western species are presented, form classification being based on the absolute form quotient. Five main groups of tables have been developed; viz., cubic foot total volume, cubic foot merchantable volume, cord volume for merchantable contents, board foot volume for saw logs and board foot volume for pulpwood. Total volume computations include volume of wood in stump and top. Merchantable volume is based on a 1.5-foot stump, a variable top diameter, increasing with size of tree in accordance with observations in actual logging operations, and a log length of 16.3 feet, with recognition of half logs when available. Variations in board foot volume, as influenced by the several log rules operating in the different provinces of Canada, is recognized in the compilation of separate form class volume tables for the different log rules. The species considered are balsam fir, jack pine, lodgepole pine, red pine, eastern white pine, black spruce and red and white spruce. Inasmuch as up to the present time form class volume tables for all the Canadian commercial trees have not been developed, a number of miscellaneous volume tables based

on d.b.h. and total height are included. These tables, which are in terms of cubic feet, have been adjusted and extended by the use of logarithmic graphs.

In addition there is included a group of miscellaneous tables giving such information as volume of bark and the relation between volume of rough and peeled wood, factors for converting volumes in cubic feet to board feet, factors for converting cubic foot volume s of standing trees to cords, relation of d.b.h. outside bark to diameter inside bark at stump, and percentile taper tables. The principal log rules in use in the several Canadian provinces are also tabulated.

Taken all in all this little book is one of the most complete and useful forester's handbooks so far published; its utility is greatly increased by its convenient pocket size and its attractive binding in stiff linen boards. It goes a long way in assisting the field man in a solution of the problem of making a reasonably accurate determination of the volumes of standing trees, and our Canadian friends deserve great credit for issuing it.

It is a matter of some regret that we, who are to the south of the International boundary, have not gone as far into the field of tree form determination as we should. This timidity on our part has not been due to a lack of appreciation of the importance of the problem, but seems to have been mainly induced by the mathematical philosophical misgivings of some of our investigators. After all, granted that tree form can be identified and form volumes can be computed with consistent accuracy, it makes little or no difference if Hoejer's original form constants do or do not apply. Form class volume tables, like any other volume tables, are only a means to an end, namely that of getting an accurate statement of tree volumes in which the variables of d.b.h., height and taper all receive definite recognition. Recognition of this fact is adequately demonstrated in this book.

H. C. Belyea,
N. Y. State College of Forestry.

The Determination of Hour Control for Adequate Fire Protection in the Major Cover Types of the California Pine Region. By S. B. Show, and E. I. Kotok. *U. S. D. A. Technical Bull. 209. Pp. 47, fig. 32, tables 17. 1930.*

The principal purpose of this bulletin is to assist the national forest fire-control organizations of northern California in the determination of the speed of attack or hour control necessary on fires in the various cover types of the region to confine the burned acreage to the acceptable minimum.

According to the authors, four main problems confront the forester and forest fighter, the solutions of which are necessary to obtain successful fire protection on the national forests and other areas subject to disastrous fires. These major problems are the determination of: the specific objective expressed in per cent of area burned (for the California pine region successful fire-protection is considered attained when the annual burned acreage does not exceed an average of 0.2 per cent for the commercial and potential timber types and 0.5

per cent for the nontimbered types); the speed of attack or hour control necessary in the various cover types; man-power and its distribution and protective improvements and their location; and the technic needed for effective control of fires.

The bulletin is based on the analytical study of 4,283 fires selected from all the man-caused fires that occurred during the period 1923 to 1928, inclusive, in the California pine region. Variations in the rate of spread of fires and consequently in the hour control needed are largely governed by the cover types, the character of the season, and the wind and relative humidity conditions. Since the cover type is the only one of these factors that remains fairly constant, it was used as the basis for determination of the hour control needed during the more difficult fire years 1924, 1926, and 1928; and the less difficult fire years 1923, 1925, and 1927. The method used to determine the required hour control was based on two direct relationships—area burned and per cent of C fires, and speed of attack and per cent of C fires.

The results of this analysis show that a three-quarter hour control generally will be required for the western yellow pine, mixed conifer, brush, grass, and woodland types; two-hour control for the Douglas fir type; and four-hour control for the sugar pine-fir and fir types. During the period 1923-1928 efforts at fire control were adequate in the less difficult years, but unsatisfactory during the more difficult years. The authors emphasize the need for more effective fire control during difficult years and recommend the above figures as the best guide to use in making fire-control allotments in the California pine region.

The bulletin also presents a discussion and analysis of hour control or total elapsed time with special emphasis on travel time. The results show that with three-quarters of an hour control about one-fourth hour will be required for discovery, report, and get-away, and one-half hour will be available for travel. The data show that the use of automobiles, where roads are available, greatly increases the effectiveness of the fire guard.

The bulletin, probably because of its statistical character, is difficult to read and for that reason will not have as many readers as it should in the fire control organizations. Two errors that add to the difficulty are found on pages 24 and 36. On page 24, figure 13, "allowable percentage," should read "allowable number," and on page 36, last paragraph, the tabular column with the heading, "acres," should read "square miles." The graph on page 35 and Table 11 on page 36 clearly indicate the need for more data for travel by automobile and foot, and by horse. These data show that during the first one-fourth hour the distances travelled are, by automobile and foot 4.3 miles, and by horse 2.7 miles as compared to distances travelled of 3.04 miles by automobile and 0.2 miles by foot. The first impressions of these data on the casual reader are that for the first one-fourth hour auto and foot travel is faster than auto travel; and that horse travel is thirteen times faster than foot travel and nearly equal to automobile travel. These impressions are erroneous.

Although the results of the study are adaptable only to the California pine region, the bulletin will be found valuable for forest fire control organizations elsewhere and for students of forestry and others interested in forest fire protection.

H. E. Malmsten,
University of California.

Profits From Farm Woods. By W. R. Mattoon, *U. S. Dept. of Agrculture, Misc. Publication No. 87, P. 18, Illus. 12. September, 1930.*

In this bulletin, Mr. Mattoon, Extension Forester, Branch of Public Relations, U. S. Forest Service, has brought together several interesting examples of profitable farm forestry as practiced in the southern states, particularly in the southern pine region. The farmers tell their personal experiences in forestry work and the illustrations serve to explain and confirm the subject material. The principal lessons taught are the value of fire protection, the profits in thinnings, and the possibilities of augmenting the farm income through judicious management of the timbered areas.

This bulletin should serve a useful purpose as an aid in extension work in the southeastern states. The bulletin is praiseworthy and somewhat unique in that it refrains from technical terms and is written in a plain direct style, easily comprehended by the average farmer for whose use it is prepared.

John R. Curry,
California Forest Experiment Station.

Cork Oak, a Forest Tree with possibilities for California. By Woodbridge Metcalf, Extension Forester, University of California. *In Monthly Bulletin, Department of Agriculture, State of California. Pp. 26, Pls. 9. Separately bound. October, 1929.*

This report was prepared for the committee on cork oak of the Sacramento Region Citizens Council formed for the purpose of determining the practicability of growing this species commercially in California. Mr. Metcalf, a member of the Committee, prepared the report after an apparently exhaustive search of the literature on the subject, together with extensive correspondence and research. The report forms a digest of what is known regarding cork oak and its utilization and is probably the most thorough compilation of material on the subject attempted in this country. While the propagation of cork appears to offer limited possibilities in the United States, the report holds the interest because of the uniqueness of this little known form of forest utilization.

The report is divided into preface; cork oak in foreign countries; growth of cork oak trees in California; disease and enemies of cork oak trees; some economic phases of possible cork production; and conclusions.

The natural range of the cork oak (*Quercus suber*) is limited to between four and five millions of acres in the Mediterraneon regions of Europe. It has been propagated in other regions, notably and extensively in the districts of Var and Alpes Martimes in France. As a mature tree, it attains a height of

between 25 and 50 feet and a diameter up to 18 inches, and occurs in stands varying in density from 30 to 60 trees per acre. The tree grows slowly and may live to be several hundred years old.

The tree is maintained throughout its range mainly by natural reproduction. Such artificial propagation as is attempted employs seed spotting mainly. The fact that the acorns germinate rapidly upon falling, combined with the extensive root system developed the first year, makes the use of nursery stock impracticable.

The value of the cork yield is comparatively low, calculated by the author as around $2.00 per acre per annum. This is based on prices prevailing for prepared cork in France, varying from 1 cent to 3 cents per pound. The cork forests of Europe are valued highly, however, for other products, mainly mast and wood. Acorns are produced either annually or biennially in large quantities and are used for the fattening of swine. Studies in Portugal have shown that 5.3 liters of acorns will produce a pound of pork and the farmers of that country calculate carefully the maxima pigs which the available mast will feed. The wood is used mainly in the production of charcoal, widely used as fuel in the Mediterranean regions.

Cork oak was introduced to California as early as 1858 and a few trees of over seventy years of age are still living. Attempts to establish large scale plantations have been unsuccessful with one exception. The reasons assigned for the failures are listed as one or a combination of the following reasons: poor planting stock, prolonged dry weather, rodent damage, improper planting, lack of cultivation in the period of establishment. The one successful plantation was established at the Chico Forestry Station in 1904. Acorns were planted in a thin gravelly soil and the trees were cultivated for the first few years. Further than this the stand has received no cultural treatment. In 1925, the plantation gave the following data: trees per acre, 383; average d. b. h., 5.5; average height, 24 feet; d. b. h. largest tree, 14.6 inches; average height, 39 feet. The plantation is in need of thinning in places and the virgin bark should be removed.

The author does not believe that the growing of cork oak offers sufficient returns in California at the present time to make it a profitable enterprise for private capital. The low returns per acre would relegate cork oak plantations to the poorer lowland soils where a tremendous fire hazard exists. Further, experiments so far conducted would indicate that the establishment of plantations is a difficult and risky enterprise. The low priced skillful labor of Europe is lacking. The natural forests of Europe are producing sufficient cork at the present to satisfy the normal needs for cork and there is no apparent scarcity in sight.

On the other hand, the author sees a decided advantage from the public standpoint in planting mountain foothills to cork oak through the betterment of watershed conditions and the improvement of the landscape. The watershed protection problem is an important one but to the group rather than

to the individual planter. The foothill region, now largely barren and unattractive, could be greatly improved in appearance through the planting of cork oak, a tree of high aesthetic values.

In his conclusion, the author recommends that a research agency, state or federal, determine: first the cultural methods under which cork oak may be established in California; secondly, methods of stripping the bark which will secure a satisfactory product with least injury to the tree; and thirdly, the suitability of California grown cork for commercial uses. He recommends further that the State Board of Forestry be requested to survey the foothill regions to determine the practicability of excluding fire from such areas as may be used in cork production and also the feasibility of establishing state forests in these regions where cork oak and other suitable trees may be grown.

The value of the report would have been enhanced as a scientific contribution by the inclusion of a complete bibliography at the end, giving the (apparently) large number of references from which material was drawn. Otherwise, the report is comprehensive and complete with a good presentation of facts and figures and with a frank statement of the drawbacks as well as the possibilities.

John R. Curry,
California Forest Experiment Station.

Forestry and Forest Fires in Arkansas. By E. Murray Bruner, *District Forest Inspector, U. S. Forest Service. Arkansas Department of Agriculture. Extension Circular No. 281. June, 1930.*

Akansas, with 22 million acres of land under some form of forest growth, is waking up to her great possibilities as a permanent producer of timber crops. Now that 20 million of these 22 million acres have been cut over, the State is gradually realizing that she must do something quickly to maintain the permanence of her forest resources.

This booklet, the author of which is a member of the United States Forest Service, was prepared in coöperation with the Arkansas Agricultural Extension Service. It contains very little that is new concerning forest fires as such, but all the available information is presented with Arkansas' conditions, problems and needs in mind. Considerable information regarding the forest area and timber resources of the State, which has likely not been published before, is included. A number of illustrations and diagrams bring the influence of fire very vividly before the reader. The booklet is beautifully printed on excellent paper and makes a good impression upon the reader. Its style should invite many residents of Arkansas to read it from cover to cover. Naturally, the general tone of the bulletin is a prayer for a better fire consciousness in the state.

E. F.

A Guide to Forestry Studies and Demonstrations on the Mont Alto and Michaux State Forests. *Research Bulletin No. 1, 1930. Forest Research Institute. Department of Forests and Waters, Commonwealth of Pennsylvania, Harrisburg.*

This little booklet of pocket size, the first one published by the recently created Forest Research Institute at Mont Alto, Pa., presents a list of the various plots and areas in the neighborhood of Mont Alto upon which some experimental work is being conducted. The booklet is called a guide and is such in fact. It gives a brief description of each area and outlines what the study constitutes or what is being demonstrated. It was published just prior to the official opening of the Institute on June 5, 1930, and was used by the many guests attending the opening as they visited the experimental areas. It was pronounced at that time not only an excellent idea but a splendid catalog of Pennsylvania's Mont Alto research projects. There are 83 numbers, each representing a different experimental area, and this in itself is interesting in that it calls attention to the large amount of previously begun investigative work which the newly created Institute inherits.

E. F.

BRIEFER ARTICLES AND NOTES

The Effect of Ultra-Violet Light on Germination of Seeds and Growth of Seedlings of *Ribes Rotundifolium* Michx

Field studies by members of the Office of Blister Rust Control, Bureau of Plant Industry, U. S. Department of Agriculture, have indicated that the removal of the forest canopy is frequently followed by the appearance of numerous Ribes seedlings. It was considered possible that this germinative activity was caused by the added sunlight, and suggested a laboratory study of this phenomenon. It was suspected that the shorter wave lengths of the spectrum were most active in this regard.

Ripe fruits of *Ribes rotundifolium* Michx. were collected from forest areas in northeastern New York in the summer of 1927. After being thoroughly dried, these were stored indoors over winter and the seeds were then removed from the dried pulp and counted. On May 3, 1928, 200 seeds were exposed to ultra-violet light for 5 minutes. The seeds were exposed on white paper at a distance of 3 feet from the lamp. Under similar conditions, another lot of 200 was exposed for 10 minutes, and a third lot of 200 seeds was exposed for 20 minutes. The remaining 300 seeds were not exposed to ultra-violet light nor otherwise treated. The light used in the treatment had a wave length of 2700 to 3200 Angstrom units and was produced by a twin-carbon arc lamp. Since it was desired to approximate natural conditions as closely as possible no attempt was made to control the heating which resulted from the carbon arc lamp.

Immediately after treatment the seeds were sown in pots of sterile soil composed of mixed sand, loam and humus. In each pot, 100 Ribes seeds were planted and lightly covered with soil. One full set of pots of treated seeds and an additional pot containing 100 untreated seeds were placed under glass in a greenhouse at Washington, D. C., in full light. A similar set of treated and untreated seeds was placed outdoors on the north side of the greenhouse, at a point where no direct sunlight fell any time of day. The pots were watered daily but were otherwise not disturbed until the observations were completed.

The untreated seeds germinated earlier than those treated with ultra-violet light. The two pots of untreated seeds in the greenhouse both showed 4 per cent germination, whereas the 100 untreated seeds placed outdoors showed 18 per cent germination. However, 5 of these latter seedlings were small and weak, and soon died, apparently from damping off. Germination of treated seeds was the same as the untreated seeds in the greenhouse (4 per cent). There was no measurable difference in the growth of the plants in the greenhouse and outdoors, until the latter part of July, when it became apparent that the greenhouse plants were outstripping

those outdoors in height-growth and foliage production.

Aside from the difference in percent of germination of one lot of untreated seeds outside, the data were of such uniform character for plants grown indoors and out that they are combined in the tabulated statement of results, Table 1.

The visible effect of the exposure to ultra-violet light was a pronounced stunting of the seedlings growing from the treated seeds. Those from seeds exposed only 5 minutes to the light began to recover their vigor six weeks later. Those from seeds treated 20 minutes required nine weeks to recover their normal vigor, and during this time only two seedlings from all of the treated lots died. All of the plants from treated seed appeared to have completely recovered from the effects of the treatment in 17 weeks after treatment, and at that time no difference in the vigor or other growth characteristics of the seedlings from the treated and untreated seeds could be discerned. The experiment was not sufficiently extensive to be conclusive but gave no indication of ultra-violet light being the factor in stimulating germination of Ribes seeds in nature. The indications are that germination of seeds and growth of seedlings of *Ribes rotundifolium* are retarded by even short exposure to ultra-violet light,

TABLE 1.

GROWTH OF *Ribes rotundifolium* SEEDLINGS FROM SEEDS TREATED WITH ULTRA-VIOLET LIGHT COMPARED WITH GROWTH OF THOSE FROM UNTREATED SEEDS

Date	Untreated seed	Treated seed
May 3, 1928	300 seeds planted.	600 seeds treated and planted.
May 19, 1928	Germination in progress.	No germination.
May 29, 1928	Germination completed (8.3 per cent).	Germination in progress; cotyledons smaller than those of seedlings from untreated seeds.
June 2, 1928	New leaves forming. Five dead seedlings from seeds which germinated weakly.	Germination in progress. All seedlings show pronounced stunting of growth especially severe in plants from seeds treated 20 minutes.
June 8, 1928	Plants 0.5 to 0.8 inches tall, with good vigor.	Germination completed (4.3 per cent). Stunting of growth very evident; least with shortest light treatment, and greatest with longest treatment.
June 16, 1928	Plants 0.6 to 1.0 inches tall.	Plants 0.1 to 0.4 inches tall. Plants from seeds treated 5 minutes showing slight recovery from stunting as evidenced by the character of new leaf formation.
June 22, 1928	Plants 0.8 to 1.4 inches tall.	Plants 0.2 to 0.5 inches tall; those from seeds treated 20 minutes making practically no growth.
July 6, 1928	Plants 1.2 to 2.5 inches tall.	Plants 0.5 to 1.5 inches tall. All plants show increased vigor.
July 21, 1928	Plants 1.5 to 3.0 inches tall.	Plants from seed treated 5 minutes equal in size and vigor to plants from untreated seeds. Plants from seeds with 10 and 20 minute treatment from 1 to 2 inches tall. Two seedlings dead apparently from crowding by more vigorous plants.
Aug. 30, 1929	Plants 3 to 7 inches tall.	Plants 3 to 6 inches tall, and equal in vigor to plants from untreated seeds. All effects of treatment apparently overcome.

but with no permanent effect on the growth or vigor of the plants from treated seeds. It is possible that the percentage of germination is reduced by exposure to ultra-violet light, but the data on this point are inadequate. The fact that a higher percentage of young plants died in the lots of untreated seeds than in the treated may indicate that disease resistance in the young plants is increased by ultra-violet light treatment of the seeds.

S. B. Detwiler,
Chief, Office of Blister Rust Control.

A Method for Sharpening Increment Borers

The writer, faced several times with the necessity of resharpening Swedish increment borers and finding it inconvenient to send the instruments to Sweden for such work, has been on the lookout for a simple method of performing the re-conditioning at home. While in attendance at the annual meeting of the Society of German Foresters last summer at Hanover, Germany, he learned of such a method from German foresters.

The only tools necessary to sharpen dulled increment borers are, first, a rod of brass, copper or other soft metal which is as closely as possible exactly the same diameter as the actual opening at the pointed end of the increment borer. This rod should be long enough so that when it is inserted into the borer it will project from each end for several inches. Second, a number of very small, very thin, and very fine files, such as are known as needle files, and are used by jewelers and others for fine mechanical work. Needle files can be bought in sets of six or twelve in any large hardware store.

The method used in sharpening the instruments, according to our German colleagues, is to insert the metal rod in the borer until the tip is just a little bit above the cutting edge, then gently filing the cutting edge until it is sharp, this must be done in such a way that the file travels not only over the steel but also over the brass rod, the rod being held against the side of the steel borer in such a way that the steel edge is not turned in. After the edge has been sharpened the three side flanges or nibs can also be filed gently. Finally the rod is removed and a small, fine, round "rat tail" file inserted and gently moved around the inside edge so as to smooth off any protruding parts of the steel or "wire edge," making the cutting edge clean and smooth from within.

Apparently this is the only method used by the Germans in sharpening their instruments, and while it is of course somewhat crude and is hand labor, I think that it is considerably better than sending the instruments all the way to Sweden. Perhaps some of the more ingenious members of our profession can take this cue and develop some kind of machine for this work. The only suggestion that I have to add is to use what are known as gouge slips to smooth off the work of the files. Gouge slips are very fine, narrow and sharp-edged whetstones, which can be purchased in most large hardware stores.

E. C. M. Richards,
Consulting Forester,
New York City.

Scandinavian Forest Fire Insurance Companies Organize A Union

The first Northern Forest Fire Congress was held in Oslo, Norway, August 14-16, 1930 and was attended by representatives of forest fire insurance companies in Norway, Sweden, Denmark and Finland. During the congress the Scandinavian Forest Fire Insurance Companies Union was organized. The purposes of the Union will be to collect and issue statistics and information on forest fire protection and insurance to the member companies, and the formulation of uniform compensation rules. An executive committee was chosen, consisting of Dir. R. Holst, Norwegian Mutual Forest Fire Insurance Company, Chairman and Secretary (Norway); Dir. K. Torngren, Svenska Veritas (Sweden); Dir. T. W. Paavonen, Forest Owners' Mutual Forest Fire Insurance Company, Helsingfors (Finland); and skovrider, C. E. Flensborg, Danish Plantation Insurance Company (Denmark). The next congress is to be held in Finland in 1932.

Rapid strides in forest fire insurance have taken place in Fenno-Scandia during the last five years. In Denmark to date over 40,000 hectares of plantations have been insured for 16,000,000 kr. by the Danish Plantation Insurance Company (Dansk Plantageforsikringsforening). Insurance began in 1898. In Sweden from 70,000 to 75,000 forest owners have insured about 8,000,000 hectares for about 800,000,000 kr. Among these are many of the larger lumber and paper companies. There are several insurance companies, including the largest general insurance companies, writing forest insurance. In Norway the Norwegian Mutual Forest Fire Insurance Company founded in 1912 has now about 13,000 policy-holders with 2,000,000 hectares and a valuation of 400,000,000 kr. In Finland the Sampo Mutual Insurance Company was founded in 1914 and the Forest Owners' Mutual in 1916. Together about 30,000 owners are insured in these companies. The area insured is estimated at 2,000,000 hectares and the valuation at about 3,000,000,000 marks.

H. I. Baldwin,
The Brown Company, Berlin, N. H.

A Pulpwood Industry in the Rockies[1]

The regional forester at Denver has awarded two sales of national forest pulpwood, aggregating more than 2,000,000 cords, to the Trans-Mississippi Development Co., a new subsidiary of the International Paper Company. Back of this announcement are years of work and hope on the part of foresters of the Rocky Mountain region. There are at least 15,000,000,000 board feet of Engelmann spruce and alpine fir on the national forests of Colorado alone, and heretofore there has been little market for these species. The railroads did not want them for ties; house builders wanted pine lumber, not spruce, and still less the nondurable alpine fir. They have been the local "despised species" which Doctor Schenck advised all foresters to watch. They were known to be

[1] From *Forest Worker*, September, 1930.

excellent woods for reduction to pulp form by the mechanical or sulphite processes, but there were no pulp mills in Colorado or within such distance that the haul was thought practicable. The foresters were confident that sometime a pulpwood market would develop; but meanwhile their silvicultural practices in the mixtures of pines, spruces, and true firs were hampered and the older spruce stands were left in storage, with the ground unproductive because growth was balanced by decay, windfall, and other causes of loss.

Finally a Wisconsin paper-making firm became interested in the possibility of getting its wood in Colorado. The areas offering the best chances for large-scale production were cruised. The timber on two units on opposite sides of the Continental Divide, one on the Rio Grande Forest and one on the San Juan, was found to be sufficient to supply a good-sized pulp mill for at least 20 years. It was appraised at $1 per cord on the more accessible unit, that on the Rio Grande Forest, and at $0.75 per cord on the San Juan unit. Widespread advertisement was started. The results surprised the foresters. Three bids for both units came from reputable paper-manufacturing companies. The high bidders offered $3.03 per cord for the Rio Grande pulpwood and $1.77 per cord for that on the San Juan. Good spruce pulpwood is in demand, and apparently all that was needed was evidence that it was available in sufficient quantities to constitute a dependable supply behind the heavy investment necessary for paper making.

Colorado will have a pulpwood industry. It is certain that, once such an industry is established, the operators will want to buy odd lots of spruce and true fir that can be brought to a railroad shipping point by other lumbermen who are getting out lodgepole pine ties as their chief product. It may confidently be expected that these sales will result in a market for pulpwood throughout the region, thus leading to better silviculture and closer utilization on the forests and to the growth of more prosperous communities of forest workers.

E. E. Carter,
United States Forest Service.

Pulpwood Cutting Experiment Begun in Adirondacks[1]

An experiment arousing considerable interest among foresters is a series of plots recently established in the Adirondacks on which different silvicultural systems for cutting pulpwood will be tried out. The Northeastern Forest Experiment Station, at the request of Finch, Pruyn & Co. of Glens Falls, N. Y., a large pulp and paper manufacturing concern, is coöperating with the Company and the Cornell School of Forestry in carrying out the experiment.

This Company owns approximately 200,000 acres of spruce forests embracing the upper reaches of the Hudson River. The Cornell University forestry department maintains a summer camp near Newcomb, N. Y., on lands owned

[1] Extract from Bulletin 135, Division of Horticulture, Massachusetts Agricultural College, by M. Westveld.

by the Company. This fortunate combination of circumstances opened the way for the three-cornered coöperative experiment now underway, and made possible the completion of the large amount of work involved in relatively short time.

The primary purpose of the experiment is to determine the feasibility of making the interval between successive cuts of pulp wood on the same area short enough to permit utilization of all the growth and to eliminate the loss from windfall and decay that is inevitable when a period of 50 years or more intervenes between cutting operations.

The experimental area embraces 150 acres and consists of five plots, each approximately 30 acres in area. The following systems of cutting will be practiced on the plots:

Plot I. Clear cut spruce and balsam fir.

Plot II. Cut spruce to 8 inches; balsam fir to 6 inches.

Plot III. Selective logging. Cut spruce to 12 inches; balsam fir to 10 inches; leaving, however, occasional 13, 14 and 15 inch spruces.

Plot IV. Girdling interfering hardwoods to accelerate the growth rate of spruce and balsam fir. Harvest to be postponed for 5 to 10 years.

Plot V. Check plot.

The study will incidentally give valuable data on what diameter limit for continued pulpwood production gives the most profitable returns per acre.

Finch, Pruyn & Co., did all the surveying incidental to the establishment of the plots, prepared the type and topographic map from which they plan to prepare a model, marked the timber for cutting and of course will undertake the logging of the area. Cornell forestry students assisted in making the reproduction and sapling tallies, and in future years will aid in remeasurement work. Detailed soil tests of these plots are being conducted by the Department of Forestry at Cornell. The Northeastern Forest Experiment Station will maintain technical supervision of the experiment, and will be responsible for the compilation of the data.

Bringing Scientific Facts to the Layman

At last the layman may know that the bite of the ordinary spiders is not poison to humans. They also may know other equally little-known facts by reading an article by A. Brooker Klugh, MA, PhD., in August, 1930, *Illustrated Canadian Forest and Outdoors.* Every time in camp we get a small skin swelling we can not identify, we conclude it must have been a spider. Experimentally it was difficult to get one to bite and when it did the result was no more serious than a pin prick.

Most spiders stab their prey with a pair of sharp claws on their heads. They then jump back. If the prey continues to struggle it may be stabbed again or several times. The spider takes only body juices which it pumps out by action of a pumping stomach.

In the same article we learn that all mice do not eat cheese. At least shrews do not and they look so much like mice the layman calls them mice. But the author says they look like mice only superfically. They have longer bodies;

longer, more pointed muzzles; canine teeth and shorter incisors. The eyes are rudimentary. They are entirely carniverous and their food consists of insects.

Any complete change of color of feathers of a bird must be by moult or replacement, never by re-pigmentation because a feather is a dead structure. What sometimes appears to be re-pigmentation is only a change in shade of the ends or edges of feathers due to wearing as a result of friction.

Scientists, by popular articles such as this, can delight and help the reader who has not had the opportunity to learn everything about nature.

L. H. DOUGLAS,
U. S. Forest Service, Denver, Col.

"FEARS OF WOOD FAMINE"

Looking through Fernow's "*Economics of Forestry*" (1902) recently the above title caught my eye. Since the comment is rather brief and has so intimate and pertinent a bearing on the situation now facing this generation in America it is quoted below entire.

Fears of Wood Famine.—The fear of a wood famine troubled the minds not only of our ancestors in this country but still more so in the countries of Europe a hundred years ago, before railroad transportation and navigation had been developed to their modern proportions, making us independent of local supplies.

This is most strikingly exhibited by the following list of titles taken from the catalogue of the library of the well-known German forest academy at Tharandt, which show that in Germany one hundred years ago forest conditions must have been somewhat similar to ours, or worse, and remedies, quack and otherwise, were being discussed as freely as with us.

Collection of economic information, how to promote wood-growth, introduce better economy in the case of wood, and prevent scarcity of wood supplies by applying building timber more usefully. 1762.

On the general deficiency of wood supplies and on the means how to meet it. 1765.

Proposition, how to meet the general decrease of wood supplies most quickly and surely, if not entirely at least for the greater part. 1788.

Prize essay on the question: How is the rapidly coming wood famine to be avoided and a proper reforestation of waste lands to be secured. 1794.

Answer to the question: How the scarcity of wood can be overcome. 1795.

Open thoughts on scarcity of wood, especially of fire wood, in Schleswig-Holstein and how to help it. 1798.

On wood famine. 1799.

Something on deficiency of wood supplies, with propositions how to cure it. 1799.

The *Catalpa* (!)[1] a sure means of avoiding the wood famine. 1800.

On some of the causes of wood scarcity which have not yet been recognized and appreciated. 1800.

Forestry, or instructions how the deficiency in wood supply may be met, and their increase promoted. 1801.

Contributions to the avoidance of a wood famine. 1801.

Open thoughts on scarcity, prices, economy, in the use of wood, and on silviculture. 1802.

Something on the general scarcity of wood in the Austrian states. 1805.

[1] This has been pointed out with similar hopes in this country. See Bulletin No. 37, Bureau of Forestry, giving a full description of characteristics of plantations of the Hardy Catalpa. L. S. M.

Investigations on the value of wood and the importance of the economic use of wood. 1806.

Wood famine and the state forests. 1840.

On deforestation and increase of wood prices, with remarks on the propositions which are made for the conservation of forests. 1843.

Short instructions for the increase and economic use of wood. 1845.

The cause of increased wood prices and the importance of the care and preservation of forests as the only means to reduce them. 1846.

Thus, among the numerous remedies proposed in Germany a century and a quarter or more ago, timber surveys, closer utilization, better silviculture and management practice, reforestation of waste lands, planting fast growing species, conservation and state forests were among the major subjects discussed as indicated by the titles of the articles cataloged. Government regulation of cutting and tax reform seem not to have received the attention then that they are receiving nowadays. Prize essay contests, however, were not lacking even in that remote day.

LOUIS S. MURPHY,
United States Forest Service,
Washington, D. C.

CENSUS OF FOREST RESEARCH IN THE NORTHEAST AVAILABLE

A "Census of Forest Investigation Under Way in New England and New York" has recently been compiled by the Northeastern Forest Experiment Station at Amherst, Massachusetts, and is now available for distribution. This census gives a brief, descriptive statement of all projects in any way related to forestry now being carried on by the various agencies in the Northeast.

A total of 292 projects are listed, of which 82 are classified as in the field of forest management; 56 in forest protection; 51 in forestation; 41 in forest mensuration; 28 in forest ecology; 21 in forest utilization; and 5 in forest economics.

Forest schools are responsible for 107 of the listed projects, and private companies rank next with 52. Agricultural colleges and experiment stations are carrying on 28 projects; other colleges and universities, 24; and botanic gardens and other scientific institutions, 11. The state forestry departments have 21 projects listed; the United States Forest Service, 25; and other federal bureaus, 12.

This publication of 126 mimeographed pages should be of real service to anyone concerned with the practical management of woodlands as well as to those actually engaged in investigative work relating to forestry. As long as the limited supply lasts, copies may be had free upon application to the Director, Northeastern Forest Experiment Station, Amherst, Massachusetts.

POWER COMMISSION REJECTS WATER POWER PERMIT

An important precedent was strengthened recently when the federal power commission on October 24 rejected applications for water power permits on Lost and Wahtum Lakes in the Mount Hood National Forest. The rejection followed recommendations for disap-

proval by the U. S. Forest Service. The application was filed with the Commission several years ago. According to a recent news bulletin from the North Pacific Region of the Forest Service, the basis of the disapproval by the Forest Service is that Wahtum and Lost lakes and the streams involved are within the Mount Hood recreation area, and that their highest value is for public recreation. Furthermore, since there are other sources of power available, there is no real economic need for the development proposed.

A committee of national experts was appointed by former secretary of agriculture W. M. Jardine to examine the Mount Hood region as a big recreational development area. This committee was composed of Frederick Law Olmstead, the landscape architect; Dr. John C. Merriam, president of the Carnegie Institution; and Professor Frank A. Waugh, landscape engineer.

After their examination of the area involved, the committee were so much impressed that they recommended that Wahtum Lake and especially Lost Lake be kept as nearly as possible in their natural condition and that no structures nor even summer homes be permitted to be built around their shores.

An International Association of Wood Anatomists

An international association of wood anatomists seems certain to become a reality through the interest and efforts of a small group of wood anatomists who held meetings at Cambridge, England, on the occasion of the Fifth International Botanical Congress, in August, 1930. Though tentative articles of organization have been prepared, final organization will likely not be consummated until the group meets again in Paris in June 1931, at the time of the International Congress on Tropical and Subtropical Woods. An organizing committee of nine members from five countries was formed with Professor S. J. Record, Yale Forest School, as secretary. This committee will render a report at the Paris meeting. The object of the Association is the advancement of knowledge of wood anatomy in all its aspects, and the activities are to include the interchange of ideas and information through correspondence and meetings; facilitating the collection and exchange of material; working toward standard terminology and descriptions; stimulation of publication of scientific articles and abstracts; and the encouragement of study and teaching of wood anatomy.

Extracted from "*Tropical Woods.*" Dec., 1930.

New York's Forest Preserve Enlarged

For the period October 1, 1929 to September 30, 1930, the State of New York purchased and added to its Forest Preserve 40,142.56 acres, of which 22,242.37 acres are in the Adirondacks and 17,900.19 acres in the Catskills. The average price for the entire year was $9.33 per acre. These additions help to block out the State's present Preserve holdings and eliminate many miles of boundary lines.

Empire State Forest Products Association Holds Silver Anniversary Meeting

Returning to hospitable Watertown, N. Y. after an absence of fifteen years, the Empire Forest Products Association held its twenty-fifth annual meeting there on October 9 and 10. Superb autumn weather and a generously large attendance—enthusiasm and confidence despite the existing business depression—these were the features of one of the very best meetings the Association has held.

As first speaker, the toastmaster introduced Dean Hugh P. Baker, of the N. Y. State College of Forestry at Syracuse, returning to this post after ten years absence in commercial work. This was Dr. Baker's first official appearance and his talk was largely reminiscent of what he had farsightedly predicted in an address of 1919. The forestry needs of 1919, he pointed out, have become more strongly those of the present day.

Next speaker was Chief Forester Piché of the Province of Quebec. With 92 per cent of Quebec's forests in public ownership and under successful administration for continuous timber production, the *practical* lessons of Quebec are of great interest to those concerned with a rational development of forest land in the State of New York.

Following Mr. Piché, Superintendent of State Forests, William G. Howard told of the plans of the Conservation Department, particularly concerning the large reforestation measures (1,000,000 acres), sponsored by the State with expenditures estimated to total $20,000,000.

All three of the speakers had been brief so that an hour had not elapsed when Toastmaster Sisson introduced Professor Floyd M. Callward of St. Lawrence University, who told interestingly of the newly developed forestry department there which he styled "the Forest Service of the North Country."

Last speaker was Secretary James R. Simmons of the N. Y. State Forestry Association, a public informational organization, dating back to 1885 and hence nearing its 50th anniversary of educational service in forestry to the people of the State.

Motion picture reels, taken by the Conservation Department, illustrating nursery and planting practice, and particularly the newly invented tree planting machine, concluded the enjoyable evening program.

BUSINESS SESSION

The business session of Thursday afternoon was purposely brief—outstanding was retiring President Sisson's "swan song" in which he recited the trials and achievements of the past twenty-five years of the Association's existence and pointed the way to still greater achievements in the future. Mr. Sisson and Mr. George N. Ostrander were chosen as liaison representatives on the questions of forest policy in the State, which various organizations are endeavoring to solve.

Outstanding among Committee reports was that of the Legislative Committee (Mr. Ostrander), the Transportation Committee (Mr. J. A. Quinlan), the Forestry Committee (Professor R. S. Hosmer, acting chairman) and the Fire

Prevention Committee (Mr. Clarence L. Fisher). Interesting discussion followed the various reports.

The following officers and directors, were unanimously elected:

President: John N. Carlisle, *President of Northern N. Y. Utilities, Inc.*, Watertown, N. Y.

Vice-President: Thos. J. Stirling, *West Virginia Pulp and Paper Co.*, Mechanicville.

Directors: Chairman, George N. Ostrander, *Finch, Pruyn & Co.*, Saratoga; C. L. Fisher, *Fisher Forestry & Realty Co.*, Lyons Falls; W. C. Hull, *Oval Wood Dish Co.*, Tupper Lake; A. A. Low, *Timberland owner in the Adirondacks*, Sabattis; George W. Sisson, Jr., *Racquette River Paper Co.*, Potsdam; F. B. Willson, *International Paper Co.*, Glens Falls.

Under the guidance of Mr. John E. Keib, forester for Northern New York Utilities and the St. Regis Paper Company (who together plant nearly 5,000,000 trees yearly), an excursion was made on the second day by some twenty members and guests to the forest plantations and power developments on the Beaver River.

Briefed from a report by

A. B. Recknagel,
Secretary, Empire State Forest Products Association.

New York Waterways Association Hears Influence of Forests Discussed

In an address before the New York State Waterways Association on "Reforestation and Flood Control," Conservation Commissioner Alexander Macdonald discussed the important part that forests play in the protection of watersheds and called attention to the benefits that will result from New York's enlarged reforesting program. He said in part:

"Severe floods of recent years, particularly those on the Mississippi River, have focussed public attention on the necessity of taking every possible measure to prevent such catastrophes in the future. It would be gross exaggeration to claim that forests alone will prevent floods in the face of heavy, long-continued rains or the rapid melting of masses of snow. On the other hand, any system of flood control which fails to take account of the important part forests play in checking rapid run-off, falls far short of solving the problem . . . .

"This kind of loss (property loss) is so direct and so apparent that it is easily understood and appreciated; but there is another loss, less apparent but none the less real, which is going on all the time where we have a stream full and running over during the spring freshets but a mere trickle the rest of the year. Where this stream is a source of power or municipal water supply the advantages of maintaining an equable flow the year 'round are tremendous.

"The bringing of large areas of forest land under public ownership in State forests, assures the protection and proper management of these lands. New York leads all the states in the acreage of forest land it owns. Our State Forest Preserve in the Adirondacks and Catskills includes 2,193,000 acres, and we have just started upon a program of acquisition and reforestation of a million acres more in other parts of the State. . . . . .

"I feel that this program of reforestation is one of the most important projects which the State has ever undertaken. There is no conflict between this

program and the agricultural development of the State, because reforestation will be applied only to the submarginal lands which cannot now, or in the future, compete with the better agricultural areas.

"Last, but by no means least, is the assurance of better watershed protection for our streams through the public ownership and scientific management of extensive State forests."

Idaho Declares War on Blister Rust

Thoroughly aroused over the alarming rapidity with which the white pine blister rust has spread in the western white pine region, the state of Idaho, the federal government and interested private timberland owners have entered into a program of control work involving the expenditure of approximately $6,000,000 within the next ten years. Expenses of the work will be shared on a coöperative basis by the three land proprietors—the federal government, the state of Idaho, and the associated private owners.

The money needed for 1931 is $320,000, to be contributed as follows: Federal government, $220,000 for the national forests with $80,000 additional to match the state and private funds on a 2 to 1 basis; state of Idaho, $20,000; private owners, $20,000.

The following year these sums will be increased to $640,000 annually, divided on the following basis: federal government, $400,000 for the national forests with $160,000 additional; state, $80,000; private owners, $80,000. Over the 10-year period the total will be approximately $6,000,000, a sum less than one-half of what Idaho realizes from the white pine lumber payroll each year.

Western white pine (*Pinus monticola*) constitutes a total of 13 billion board feet of the standing timber in Idaho with a potential value exceeding $440,000,000. It occurs on 3,000,000 acres. In 1929 this species comprised 43 per cent of the total lumber cut in Idaho.

Washington Association Develops Improved Fire Fighting Appliances

Through the efforts and encouragement of the Washington Forest Fire Association, of which C. S. Cowan, a senior member of the Society is chief fire warden, several important improvements have been made in hose couplings, nozzle holder extensions and fire-line plows. Mr. Cowan furnished the descriptions from which this note was prepared.

The improved hose coupling is a cast brass union, both halves of which are identical. One half engages with the other through the agency of recurved "ears," two on each half. Running from each ear for about 120 degrees around the coupling is a projecting rim, leaving a space of about three-quarters of an inch before the opposite ear is reached. The inner face of each ear is machined to fit the rim. To join two hose lengths the coupling halves are so held that the ears slip over the spaces above mentioned, and a twist given to the hose of about 90 degrees. The rim slopes slightly to draw the two halves of the union or coupling tightly together. The rim itself is so built with a "step lock" that should a joint become loose, the two

hose lengths will not be forced apart. Increased tightness is secured through a soft rubber washer, flanged to prevent it from dropping out while the hose is uncoupled. The new coupling is named the "Presto." Inasmuch as both halves are identical, no attention need be paid to which end of a hose length is laid out in stringing a line from pump to fire. Other advantages claimed are its water-tightness (the greater the head the tighter the joint); it has no loose parts; no spanner wrench is needed; a joint can be made more quickly than with present couplings and the hose can be dragged through brush without getting "hung up." In weight and cost it compares favorably with the couplings now in use. An adapter is now available to fit the new coupling to standard couplings and nozzles.

In order to reach fires in high snags, when back-pack tanks are used, there has been devised a holder, which, with an additional 15-foot length of hose, permits holding the standard back-pack tank pump nozzle to higher elevations and at any angle. A stick, cut locally, is used for the extension rod while a ferrule holding the nozzle fits over its end.

To improve upon present tractor-drawn plows for use on the rough and heavily littered ground of the Douglas fir region, a new plow was developed from the present "Killefer Pan-buster." A connecting brace was welded in the angle of the raising frame to prevent spreading. The plow proper was carried 30 inches to the rear by welding on a gooseneck of 60-pound railroad steel, strengthened between web and flange. On this was welded a two-sided plow having shares of boiler plate. The tires were reinforced by the addition of 5.5-inch channel iron. The lighter size of pan-buster was used in preference to the next larger size because of the increased weight of the latter and the consequent greater difficulty in transportation.

First Primitive Areas Set Aside

The first of a number of mountain and forest areas recommended for reservation as primitive areas to receive final and formal official sanction are in the North Pacific Region of the U. S. Forest Service. Final approval was made October 30 of areas embracing a total of 288,640 acres, distributed as follows: Mountain Lakes Primitive Area on the Crater National Forest, 13,440 acres; Mount Jefferson Primitive Area on the Mount Hood, Deschutes and Sanitiam National Forests, 52,200 acres; and the Eagle Cap Primitive Area within the Wallowa and Whitman National Forests, 223,000 acres. These areas are in high mountain regions and are of limited value for lumber exploitation but very valuable for retention in their primitive condition.

New England's Forest Resources

The importance of New England's natural resources and agriculture is indicated in a fact folder on these two subjects, just issued by the Research Committee of the New England Council. The information concerning the forests of New England follows:

"The area of New England represents but 2 per cent of the area of the United States and two-thirds of it is in forest land representing 5.5 per cent of the forest area of the country.

"The present stand of saw timber is estimated to be 49,799,000,000 board feet, roughly 2¼ per cent of the estimated saw timber of the United States. There are only about 3100 square miles of virgin timber remaining in New England. More than 75 per cent of this stand is spruce, fir, white pine and Norway pine. The balance is largely birch, beech, maple and oak.

"In 1928 the production of lumber in New England amounted to 765,419,000 board feet or 2.2 per cent of the lumber production of the United States. This is about one-third the amount of lumber consumed annually in New England."

Origin of Forest Service Emblem[1]

When in 1905 the newly named Forest Service desired to supplant the circular nickeled badge that previously showed the authority of forest reserve officers, a designing contest was instituted at Washington, D. C. Gifford Pinchot, then Chief Forester, Overton W. Price and E. T. Allen comprised the judging committee and no rules of design were imposed. Not a single design, however, satisfactorily combined essentials. So a new start with specified requirements, was necessary. As a suggestion along this line, Allen, who as one of the judges was insistent upon a conventionalized shield of some kind to assure quick public recognition of authority and also suggest public defense as a forestry object, was tracing the Union Pacific Railroad shield emblem from a time folder which lay on his desk and inserted the letters "U. S." conspicuously. W. C. Hedge, now dead, who was watching him, suddenly sketched a conventional coniferous tree on a cigarette paper and laid it between the two letters to complete the symbolism. Another minute and "Forest Service" was written above and "U. S. Department of Agriculture" below. This three-minute combination of a railway folder and a cigarette paper satisfied all three judges so the contest was called off.

Cellulose Able to Sustain Man[2]

In the course of his discussion of "Research in the Cellulose Industries" at a recent meeting of the Franklin Institute, Philadelphia, Dr. Ralph H. McKee, professor of chemical engineering in Columbia University, hinted at the possible future importance of cellulose in the life of mankind.

Dr. McKee made the illuminating statement that, deprived of other materials, man could well-nigh subsist on cellulose and its products.

To bring back to the states that have lost, and are losing, wood-using industries, Dr. McKee suggests the development of "fast-growing varieties of trees

[1] From *The Forest Pioneer*, October, 1930. Albuquerque, N. Mex.
[2] Adapted from National Lumber Bulletin Vol. X, No. 12, August. 1930

whose wood is particularly suitable for pulp, and the purchasing of abandoned lands for three to eight dollars an acre." He believes tree hybridization that has yielded conspicuous results in certain fruit and nut trees, and in a few ornamental varieties, should be applied to forest trees suitable for pulpwood and lumber.

In 1916, in an address before the American Paper and Pulp Association, Dr. McKee suggested a solution of the shortage of raw material for the wood-using industries. He recommended that twenty-five or thirty varieties of poplar, known in this country and abroad, be collected and crossed and the resulting hybrids tested for pulp-making qualities. Attempts to get organizations interested in reforestation to support such experiments were not successful until about ten years later, when the price of pulpwood had doubled. The Oxford Paper Co. agreed to finance the investigation, and the work was done under Dr. McKee's direction in coöperation with the New York Botanical Garden. There are five hybrid poplars in existence. The Lombardy (which was an accidental hybrid about 400 years ago in northern Italy) is a male tree which has been propagated by cuttings or slips. There never has been a female Lombardy poplar, and Dr. McKee says there has been only one Lombardy poplar tree, because the various trees are but parts of the original hybrid.

The seedlings of the hybrids were propagated further by cutting them up into pieces ten or twelve inches long and storing them for the winter. In the spring they were planted in the field nursery, and by the following September each piece had become a tree six or seven feet tall. During the period of cross-breeding, fiber studies were made, and it was found that fiber length and speed of growth were correlated—the fastest growing hybrids having the longest fiber. The studies also disclosed that the volume of growth—the weight of wood produced—of the new hybrids is from ten to fourteen times as much per year as for the wild poplars growing under similar conditions. The preferred hybrid grows to a diameter of eight inches in eight years.

WOOD VS. COTTON

Dr. McKee also made a comparison of wood and cotton.

After a tract of land is cut over it is customary to let the saplings that remain grow to trees. Such "natural reforestation," as it is called, yields only about six cords of useful wood per acre in sixty years—an average of 250 pounds of pulpwood, or 125 pounds of cellulose per acre-year. For cotton, the yield per acre-year is 150 pounds of cellulose; for flaxstraw, 100 pounds; and for cornstalks, nearly 500 pounds. Well-managed plantations of pulpwood using wild species will produce about 2,000 pounds of cellulose per acre-year. From the new hybrid poplar plantations it is expected to realize 80 cords of pulpwood per acre in twelve years—an average of 16,000 pounds of merchantable wood per acre-year, equivalent to 8,000 pounds of cellulose per acre-year.

The poplar is also suitable for certain lumber utilization, and it has been suggested that hybridization of other trees may develop improved lumber-producing trees.

A few of the outstanding reasons for using hybrid poplars for reforestation are that:

1. Wood is much more compact than forage crops. This is an advantage in handling, storage, and protection from decay, as well as in pulp-mill operations.

2. Cut-over hillsides are just as satisfactory for growing hybrid poplars as high-priced farm land.

3. The hybrid can be bred to the best form, both for yield and for quality.

4. The large yield and short period of growth permit building of permanent roads and camps, as the cut-over areas are replanted.

5. The trees can be left growing until wanted. Instead of spoiling, like a forage crop, they increase in size. It is not necessary to market the wood when the price is low.

6. The timber has a diversified market as lumber of various sorts and pulpwood.

7. The investment risk on a pulpwood mill is very small as compared to that on a pulp mill using farm by-products, for wood may be handled on a large scale, whereas straw and cornstalks would be supplied to the pulp mill by many small growers.

8. Perhaps the most impressive conclusion is that all calculations indicate that more dollars per acre-year of wood can be grown than dollars per acre-year of wheat or other common farm crops.

"In the case of such a complex problem as reforestation, a single company can make but slight headway," concluded Professor McKee. "The work must be supported by many organizations in all parts of the country. For example, a dozen organizations might engage in hybrid poplar propagation and utilization without interfering in the least with one another."

Lumber Association Laboratory Under Way

The laboratory organized in March, 1930 by the National Lumber Manufacturers Association is actively pursuing investigative work in the properties of wood products. The laboratory has quarters in the chemistry building of the Catholic University of America, at Washington, D. C. It is intended principally for emergency problems, and supplements the work of the U. S. Forest Products Laboratory and other similar investigative organizations. The chief activity to date has been a number of tests of column protection with a view to developing the most effective types of such protection. The laboratory is to concentrate on problems requiring immediate attention and having the greatest importance from the viewpoint of future market development.

The laboratory is equipped with controlled humidity and temperature chambers for conditioning material to be used for test purposes and for the testing of moisture proofing and shrinkage prevention treatments and methods by alternating exposure to low and high humidity.

By arrangement with the Mellon Institute of Pittsburgh, the Laboratory is employing the floor abrasion apparatus

developed by the Institute in abrasion tests on various types of wood flooring, with and without protective treatment and coatings.

A Dunlap fire test apparatus for fire-retardant treated wood is in use for testing proprietary treatments for this purpose and as a control in making fire tests of structural assemblies employing fire-retardant treated wood.

The Laboratory is equipped with two fire test furnaces, one for developing the fire resistance of short sections of timber columns protected in various ways with wood, and the other for investigating the fire resistance periods of partition and door panels employing wood as the principal component.

Some of the problems under investigation or on the investigative program include fire-retardant treatments; fire tests of doors, floors, and scaffolds; the heat transmission of wood; moisture proofing processes; shrinkage prevention; mechanical tests of laminated structures and joisted floors; and others. The investigations, it is thus apparent, concentrate upon the utilization rather than the manufacturing phases of lumbering. While the accomplishment to date is small due to limited funds, the fact that the investigative activities of the national association are now organized and the idea of such work is accepted by its directors bids fair to put the lumber industry in line with other industries that have undertaken researches and investigations for the improvement of their processes or to make their products more acceptable to the markets.

Rosenwald Museum to Feature Forestry

The Museum of Science and Industry, founded in Chicago as the result of a gift of $3,000,000 by Julius Rosenwald, is to devote part of its space to an exhibit of the history, development, and present-day practices of forestry, lumbering, and the manufacture of wood products. There are to be "displays of the actual operations, technical processes, and historical developments" in the fields mentioned, according to Helmuth Bay, research associate in forestry at the Museum. The donor's idea for the museum was developed as a result of study of similar museums in Europe. Mr. Bay expects to demonstrate every step in a well-managed lumbering operation from cruising the timber and preparation of management plans through logging, milling, lumber conditioning and the manufacture of specialties like veneers and plywood, naval stores, cellulose, pulp and paper and a number of other forest products. A number of scale models are already in process of manufacture. The Museum proposes to direct attention in its exhibits to the cultural effect which each particular process has had upon man.

Swiss Forestry Journal Describes Whitney Forest

The *Journal Forestier Suisse*, the official organ of the Society of Swiss Foresters, devotes considerable space in its November, 1930, issue to a description of the Eli Whitney Forest of the New Haven Water Company. The article is

in the nature of a review of the profusely illustrated bulletin of the Yale Forest School describing this property. The article, in some detail describes the forest types and the program of management of this valuable demonstration forest and uses many illustrations from the original text.

North Dakota Chemist Joins Forest Products Laboratory

Dr. Elwin E. Harris, for the past seven years professor of organic chemistry in the University of North Dakota at Grand Forks, has joined the Derived Products section of the U. S. Forest Products Laboratory here. Dr. Harris will be engaged in the laboratory's investigation of lignin which has just been inaugurated on an intensive basis.

His work for the M. A. and Ph. D. degrees was completed at the University of Minnesota.

Entomologist Added to Syracuse Staff

R. L. Taylor has been temporarily engaged as instructor in the department of forest entomology at N. Y. State College of Forestry. Mr. Taylor obtained his B. S. degree at Cornell in general forestry and in entomology, his special problem being insect parasites of the white pine weevil. He graduated from the Bussey Institute at Harvard University with the degree S. M. and Sc. D., his major being in entomology. Prior to coming to Syracuse he finished a research problem on the birch leaf-mining sawfly for the Maine forest service.

Duthie Made Chief of Information

George A. Duthie, supervisor of the Black Hills National Forest for the last 21 years, has been appointed chief of the division of information in the U. S. Forest Service, succeeding Ward Shepard, who recently resigned to enter private forestry work.

Mr. Duthie is a native of Michigan and a graduate of the University of Michigan, where he received his master's degree in forestry in 1909. Before becoming head of the Black Hills National Forest, he served on the Pike National Forest in Colorado, the Medicine Bow National Forest in Wyoming, and the Harney National Forest in South Dakota.

Erratum

On page 942 in the November 1930 issue, read *less* for *more*, in the last line of the leader to the article by F. J. Hallauer entitled "Will Sustained Yield in Lumber Operation Come Through Regulation or Through Competition?"

CORRESPONDENCE

Editorial Note

With this issue of the Journal there is inaugurated a *Correspondence* department. The purpose of the new department is to offer a more convenient medium for publishing the expressions of members. This seems to be particularly desirable at the present time when individual members of the Society are giving so much independent thought to controversial subjects, but do not care to prepare formal articles for expressing their views. Many would write letters if they were certain of a special department in the Journal for their appearance. Letters are oftentimes more meaty and more to the point than formal articles, and letters also are more personal, to say nothing of requiring less time for their preparation. The *Correspondence* department should eventually be an important means of enlivening the pages of the Journal, and it may be used by the members of the Society and others who read the Journal for expressions or comments upon various subjects, or on articles that have appeared in the Journal itself; it is offered also as a safety valve for feelings which one may not care to work into an article. The editor will adopt a liberal viewpoint toward correspondence intended for this department, but he reserves the right to exercise his judgment as to the propriety of publishing it. He will, of course, obtain the writer's permission for publication in the case of controversial points.

Copy intended for publication in a specific number should be in the editor's hands not later than one month prior to date of publication.

Emanuel Fritz,
Editor-in-chief.

Cary Adds Emphasis to Churchill's Article

Referring to "*Private Forestry, Some Requirements and Opportunities,*" Journal of Forestry, October, 1930, Mr. Austin Cary writes:

"I am greatly pleased that you drew Mr. Churchill out. He makes three points that I hope the profession will carefully note:

"1. That a forester in business employ must have the respect and confidence of his employers. He might have added that he must work for them and not primarily for ideals.

"2. That forest business must make money.

"3. That under this limitation some land must be pretty much neglected."

Austin Cary,
Starke, Florida.

Romell Calls the Editor to Task

Editor, Journal of Forestry,

Dear Sir: Please let me correct an error of interpretation which has slipped into the editorial summary of my paper *Forest Soil Research in Relation to Forestry,* in the October issue of your Journal.

The essence of my paper is given in this summary in the following words: "Forestry operations must disturb natural conditions as little as possible." I would not agree on that, unconditionally, and I was much surprised to read this interpretation of my views.

The thesis of the summary is, of course, true in case the soil conditions are ideal in the undisturbed forest. But, as stressed in my paper, p. 843, they by no means always are. There is no doubt that forest production could be substantially increased over large areas of this planet, if we could afford to change radically soil conditions, say by sufficiently heavy or frequent liming. The point I tried to make in my paper was precisely that we *cannot afford* to do these things, however desirable they may be, because "up to the present day the financial returns from forestry have been too low, or too slow, to warrant any but the very cheapest, and mainly indirect, soil improvement measures," p. 841.

To take one illustrative example: Probably one of the more important among the differences between abandoned, worn-out farm land and a good forest soil is its greater compactness. This could be remedied immediately, e. g., by working the soil with Siemen's soil shredder. Provided the effect lasts until the young stand has closed itself and the formation of a forest soil is well started, it might be entirely possible to obtain in this way a decent stand already in the first generation. Otherwise the first tree crop might serve mainly to prepare the ground for following ones. Thus, it would seem indicated in connection with the present reforestation program to experiment with different methods of thorough soil working—if it were not for the costs of the treatment, which would probably be prohibitive, even though the reforestation may not be supposed to be a paying business.

It is for such reasons that "the actual tendency, even in countries with intensive silviculture, is not towards, but against the transformation of silviculture into a kind of gardening," p. 842. The soil is neither neglected nor let alone by the best modern forestry, but the soil improvement is largely done with the axe, by practising good silviculture, adapted to the local natural conditions. An urgent need in this country is the development of such practices. Stressing this, as I did in my paper, is not advocating a silviculture disturbing "as little as possible natural soil conditions."

Yours very truly,

L. G. Romell,
Cornell University.

Smith Answers Woodbury

Washington, D. C., October 31, 1930

Mr. T. D. Woodbury,
Assistant Regional Forester,
U. S. Forest Service,
Ferry Building,
San Francisco, Calif.

My Dear Wood: I was very much interested in reading your article entitled, "Why Sawlog Forestry on the California National Forests," appearing in the May 1930 issue of the Journal of Forestry, and especially in the substantial agreement as to basic facts underlying the National Forest silvicultural policy in California as covered by my letter, which was published in the November 1929 Journal. Apparently you received the impression from my letter that I was interested primarily in the *immediate* utilization of the forest. That is not the case. I agree with you that we are dealing with centuries, not years or decades. I am not at all worried over the possibility of disposing of present stands of large virgin timber, therefore reference to my interest in the prosperity or otherwise of existing sawmill operations in California is without point. The whole basis for my letter was the thought that we should now be planning for many years ahead and that it is essential in my opinion that the latest information on possible future demand must be taken into consideration in formulating such plans rather than relying entirely upon policies based upon data which may or may not fit the case.

In the paper which you presented at the annual meeting of the California Section, Society of American Foresters in San Francisco on December 17, 1929, which also appeared in the May Journal, you laid down two premises upon which your cutting policy in California is based. They appeared on page 696. I will not quote them in full. First, "that sawn lumber is a basic commodity for which there will be a continuous demand. * * * Secondly, that species of high intrinsic value at present will maintain a relatively high value in the future." Based on these premises I am inclined to believe that the silvicultural policy on the National Forest of California is just about 100 percent correct. My difficulty, however, is in accepting your premises in the light of economic facts concerning supply of and demand for lumber as developed during the past year or so. Naturally, not starting from these premises, I cannot arrive at the conclusions which underly your established silvicultural policy. Without accepting mine you naturally cannot agree with me. Future events may prove that we are both wrong.

Very sincerely yours,

C. Stowell Smith,

National Lumber Manufacturers Association.

SOCIETY AFFAIRS

"Leaders" to Be Continued

A sufficient interest has been expressed by readers of the Journal in the brief synopses, abstracts or comments that are now preceding major articles to warrant their continuance, at least for the present. Preparation of these "leaders" almost doubles the time required for preparing an article for the printer. The editor would appreciate it, therefore, if authors would themselves prepare them, subject, of course, to his approval. Any "leader" prepared by the editor, which might in any way misinterpret the article will be submitted to the author for comment. This has not been possible until recently because of the necessity of preparing a large number of articles at once.

Emanuel Fritz,
Editor-in-chief.

Kirkland Apppointed to Editorial Staff

Professor Burt P. Kirkland, University of Washington, has been appointed to the editorial staff of the Journal by President Paul G. Redington. Professor Kirkland takes the place held by Mr. E. O. Siecke, State Forester of Texas, who resigned because of press of official duties. Professor Kirkland will look after the department of forest protection and administration, beginning with the January issue.

Southwestern Section Meets at Roosevelt

The Southwestern Section held a splendid meeting at Roosevelt the last week in October in connection with the Forest Supervisors' meeting. All the Forest Supervisors and a number of Regional office men, and several University men were present. No formal papers were presented, but there was a lively discussion on responsibilities of the Forest Service in the protection of watersheds.

Council Endorses Tree Planting to Commemorate Washington Anniversary

The United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington is an activity of the Federal Government, supported entirely by congressional appropriations. It has no commercial aspects whatever. The purpose of the Commission is to promote and organize throughout the United States a truly nation-wide celebration in honor of the founder of the American Government. This celebration is to begin February 22, 1932, and continue until Thanksgiving Day of that year.

The observance of the bicentennial of George Washington's birth is not to be in the form of an exposition or other

material display. It is intended to be an expression from the hearts of all Americans of appreciation for the life and services of our nation's greatest citizen. The Commission is planning to aid this observance in every home, church, school and among all groups of people in every community, hamlet, town and city in the country. There is to be no concentration of effort in behalf of the National Capital or any other single city. Each State is to have a State Commission to work in coöperation with the National Commission.

The movement is strictly patriotic, intended to revive among all our people a love of country and devotion to the ideals so strongly exemplified in the life of George Washington. The cause is for better citizenship and better Americanism among us all.

The Commission includes the President, Vice-President, Speaker of the House and four members from each house of Congress, and a group of citizens appointed by the President as Chairman. Directors are Lt. Col. U. S. Grant, 3rd, and Representative Sol Bloom.

Taking up the call for coöperation the American Tree Association, Charles Lathrop Pack, President, has launched upon a nation-wide plan to encourage the planting of trees in commemoration of the 200th anniversary of Washington's birth. The bicentennial commission has thought well of the Association's plan and has appointed it to take over the tree planting phase of the national program of commemoration.

A bulletin from the American Tree Association says: "This memorial tree and forest planting campaign gives every forester a great opportunity to place forestry before the people of this community. Is there an opportunity for a memorial town forest in your territory?" It asks to be advised of any chance of planting trees and organizing a program in connection with the George Washington bicentennial.

The Council of the Society of American Foresters at its June 1930 meeting endorsed the tree-planting plan in the following resolution: "The Society of American Foresters endorses the planting of memorial trees and even more strongly endorses the planting of groves and forests in commemoration of the 200th anniversary of the birth of the father of our country."

The American Tree Association's plan has already met with considerable success, and planting, as a result of its effort, is already under way. It has prepared a booklet giving directions for tree planting which may be had for the asking.

Announcement of Candidates for Membership

The following names of candidates for membership are referred to Junior Members, Senior Members, and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the December Journal, without question as to eligibility; the names have not been passed upon by the Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before February 10, 1931. Statements on different men should be submitted on different sheets. Communications relating to candidates are considered by the Council as strictly confidential.

FOR ELECTION TO GRADE OF JUNIOR MEMBER

Name and Education	*Title and Address*	*Proposed by*
Bernier, Joseph L. N. Y. State, B. S. F., 1924.	Attending Yale Forest School, New Haven, Conn., working for Masters Degree.	New England Sec.
Bixby, Thomas Perry Univ. of Me.; Yale Univ.	Junior Forester, White Mountain Apache Indian Reservation, Ariz.	Southwestern Sec.
Briem, A. J. Univ. of Wash. Forest School, 4 years.	Officer in charge, Sauk River Lbr. Co. Timber Sale, Darrington, Wash.	North Pacific Sec.
Brinson, Paul A. Univ. of Mich., B. S. F., 1929.	Working for M. S. F. degree at School of Forestry and Conservation, Univ. of Michigan, Ann Arbor, Michigan.	North Pacific Sec.
Bullock, W. Paul Cornell Univ., B. S. F.	Wood buyer and assistant forester, Mead Corporation, Kinsport, Tenn.	Appalachian Sec.
DeLapp, Virgil C. Univ. of Wash.; Univ. So. Calif.	Principal Forest Ranger, Monterey Div., Santa Barbara Forest, King City, California.	California Sec.
Eastman, A. W. Common School.	Senior Lumberman, U. S. Forest Service, Seattle, Wash.	North Pacific Sec.
Ernst, Emil F. Univ. of Mont., B. S. F., 1929.	Temporary Park Ranger, National Park Service, Yosemite, California.	California Sec.
Hall, C. C. Grammar School.	Forest Supervisor, Saukiau National Forest, Albany, Oregon.	North Pacific Sec.
Holt, Reginald Woodbury Yale, B. A., 1928; M. F., 1930.	Student salesman, Weyerhaueser Lumber Co., Longview, Washington.	North Pacific Sec.
Honeycutt, E. E. Univ. of Calif.	Setting Engr., Sugar Pine Lbr. Co., Minarets, California.	California Sec.
Johnston, James W., Jr. N. Y. State, B. S. F., 1930.	Graduate Student, Harvard Forest, Petersham, Mass.	New England Sec.
Logan, Paul H. Cornell Univ., B. S. F., 1926.	Junior Forester, Olympic National Forest, Olympia, Washington.	North Pacific Sec.
MacMaster, Maxwell, Jr. Yale Forestry School.	Forester, Stanley Incorporated, Fayetteville, Tennessee.	Appalachian Sec.
McReynolds, Kenneth P. Oreg. State, B. S. F., 1929.	Junior Forester, Umpqua National Forest, Roseburg, Oregon.	North Pacific Sec.

Miller, Howard A. Simpson College, A. B.; Yale, M. F.	Junior Forester, Upper Mississippi River Wild Life and Fish Refuge, Federal Building, Winona, Minnesota.	Minnesota Sec.
Olsen, C. C. Univ. of Idaho, B. S. F., 1926.	Supt. of Construction, Cascade National Forest, Eugene, Oregon.	North Pacific Sec.
Stoughton, Margaret C. Iowa State, B. S. F.	Junior Forester, Appalachian For. Exp. Sta., Asheville, North Carolina.	Appalachian Sec.
Sylvester, Earle High School.	Forestry Division, Brown Co., Berlin, N. H.	New England Sec.

FOR ELECTION TO GRADE OF SENIOR MEMBER

Barrett, Leonard I. Univ. of Mich., B. S. F., 1924; M. S. F., 1926. (Junior Member, 1925)	Asst. Silviculturist, Central States Forest Exp. Sta., Columbus, Ohio.	Ohio Valley Sec.
Lodewick, John Elton N. Y. State, B. S. F., 1919; M. S., 1920; Ph. D., 1927. (Junior Member, 1923).	Prof. of Wood Technology, Virginia Poly. Inst., Blacksburg, Virginia.	Appalachian Sec.

FOR ELECTION TO GRADE OF ASSOCIATE MEMBER

Randall, Charles E. Leland Stanford Univ., A. B., 1920; George Washington Univ., M. A., 1930.	Editor, in charge of Educational Coöperation, U. S. Forest Service, Washington, D. C.	Washington Sec.

W. G. Howard,
Member of Council in Charge of Admissions.

SOCIETY OFFICERS

Officers and Members of Executive Council

President, Paul G. Redington, Biological Survey, Washington, D. C.
Vice-President, John D. Guthrie, Forest Service, Portland, Oregon.
Secretary-Treasurer, E. Morgan Pryse, Office of Indian Affairs, Washington, D. C.

Executive Council

The Executive Council consists of the above officers and the following members:

	Term expires		Term expires
R. Y. Stuart	Dec. 31, 1931	Clifton D. Howe	Dec. 31, 1933
Aldo Leopold	Dec. 31, 1931	Stuart B. Show	Dec. 31, 1933
T. T. Munger	Dec. 31, 1931	Ralph S. Hosmer	Dec. 31, 1933
W. G. Howard	Dec. 31, 1931	Claude R. Tillotson	Dec. 31, 1933

Member in Charge of Admissions

W. G. Howard

Section Officers

Allegheny

G. H. Wirt, Chairman, Department of Forests and Waters, Harrisburg, Pa.
R. D. Forbes, Vice-Chairman, Allegheny Forest Exp. Sta., 3437 Woodland Ave., Philadelphia, Pa.
H. F. Round, Secretary, Forester's Office, Pa. R. R. Co., Philadelphia, Pa.

Appalachian

E. H. Frothingham, Chairman, Appalachian Forest Experiment Station, Asheville, N. C.
Verne Rhoades, Vice-Chairman, P. O. Box 1927, Asheville, N. C.
W. K. Beichler, Secretary, N. C. Dept. Cons. & Devel., Asheville, N. C.

California

E. I. Kotok, Chairman, 332 Giannini Hall, Berkeley, Calif.
Woodbridge Metcalf, Vice-Chairman, 231 Giannini Hall, Berkeley, Calif.
M. R. Brundage, Secretary, 332 Giannini Hall, Berkeley, Calif.

Central Rocky Mountain

Allen S. Peck, Chairman, Forest Service, Denver, Colo.
John W. Spencer, Vice-Chairman, Forest Service, Denver, Colo.
J. A. Donery, Secretary, Forest Service, Denver, Colo.

Gulf States

G. D. Marckworth, Chairman, Louisiana State University, Baton Rouge, La.
E. A. Ziegler, Vice-Chairman, Southern Forest Experiment Sta., New Orleans, La.
Robert Moore, Secretary, University Station, Baton Rouge, La.

Intermountain

Lyle F. Watts, Chairman, Forest Service, Ogden, Utah.
Earl C. Sanford, Vice-Chairman, Forest Service, Ogden, Utah.
S. B. Locke, Secretary, Forest Service, Ogden, Utah.

Minnesota

R. N. Cunningham, Chairman, Lake States Forest Exp Sta., University Farm, St. Paul, Minn.
Raymond E. Stevens, Secretary-Treasurer, Minn. Land Economic Survey, University Farm, St. Paul, Minn.

New England

Austin F. Hawes, Chairman, State Forester, Hartford, Conn.
A. C. Cline, Secretary, Harvard Forest, Petersham, Mass.

New York

Arthur S. Hopkins, Chairman, Conservation Dept., Albany, N. Y.
H. C. Belyea, Secretary, College of Forestry, Syracuse, N. Y.

Northern Rocky Mountain

I. W. Cook, Chairman, University of Montana, Missoula, Mont.
S. N. Wyckoff, Vice-Chairman, U. S. Forest Service, Spokane, Wash.
I. V. Anderson, Secretary, U. S. Forest Service, Missoula, Mont.

North Pacific

R. H. Chapler, Chairman, U. S. Forest Service, Portland, Ore.
Fred W. Cleator, Secretary-Treasurer, Box 4137, Portland, Ore.

Ohio Valley

E. M. Bruner, Chairman, 516 Federal Bldg., Louisville, Ky.
T. W. McKinley, Secretary-Treasurer, Isaac Bernheim Estate, Clermont, Ky

Ozark

William L. Hall, Temporary Vice-President, 900 Prospect Ave., Hot Springs, Ark.

Southeastern

Harry Lee Baker, Chairman, State Forester, Tallahassee, Fla.
H. A. Smith, Secretary, Asst. State Forester. Tallahassee, Fla.

Southwestern

G. A. Pearson, Chairman, Forest Service, Flagstaff, Ariz.
D. A. Shoemaker, Vice-Chairman, U. S. Forest Service, Albuquerque, N. M.
Stanley F. Wilson, Secretary, U. S. Forest Service, Albuquerque, New Mexico.

Washington

Ward Shepard, Chairman, 1039 Natl. Press Bldg., Washington, D. C.
F. W. Reed, Vice-Chairman, Natl. Lumber Mftrs., Transportation Bldg., Washington, D. C.
Alfred E. Fivaz, Secretary, Bureau Plant Industry, Washington, D. C.

Wisconsin

F. G. Wilson, Chairman, College of Agriculture, Madison, Wis.
Edward C. Peck, Secretary, 2001 Monroe St., Madison, Wis.